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THE UNITED STATES
STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT COMPANY

(Hitachi Kokuki KK)

CORPORATION REPORT NO. VII

(Airframes and Engines)

Aircraft Division

February 1947

P 2 2

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This report was written primarily for the use of the United States Strategic Bombing Survey in the preparation of further reports of a more comprehensive nature. Any conclusions or opinions expressed in this report must be considered as limited to the specific material covered and as subject to further interpretation in the light of further studies conducted by the Survey.

FOREWORD

The United States Strategic Bombing was established by the Secretary of War on 3 November 1944, pursuant to a directive from the late President Roosevelt. Its mission was to conduct an impartial and expert study of the effects of our aerial attack on Germany, to be used in connection with air attacks on Japan and to establish a basis for evaluating the importance and potentialities of air power as an instrument of military strategy for planning the future development of the United States armed forces and for determining future economic policies with respect to the national defense. A summary report and some 200 supporting reports containing the findings of the Survey in Germany have been published.

On 15 August 1945, President Truman requested that the Survey conduct a similar study of the effects of all types of air attack in the war against Japan, submitting reports in duplicate to the Secretary of War and to the Secretary of the Navy. The officers of the Survey during its Japanese phase were:

Franklin D'Olier, *Chairman.*
Paul H. Nitze,
Henry C. Alexander, *Vice Chairmen.*
Harry L. Bowman,
J. Kenneth Galbraith,
Rensis Likert,
Frank A. McNamee, Jr.,
Fred Searls, Jr.,
Monroe E. Spaght,
Dr. Lewis R. Thompson,
Theodore P. Wright, *Directors.*
Walter Wilds, *Secretary.*

The Survey's complement provided for 300 civilians, 350 officers, and 500 enlisted men. The military segment of the organization was drawn from the Army to the extent of 60 percent, and from the Navy to the extent of 40 percent. Both the Army and the Navy gave the Survey all possible assistance in furnishing men, supplies, transport, and information. The Survey operated from headquarters established in Tokyo early in September 1945, with subheadquarters in Nagoya, Osaka, Hiroshima and Nagasaki, and with mobile teams operating in other parts of Japan, the islands of the Pacific, and the Asiatic mainland.

It was possible to reconstruct much of wartime Japanese military planning and execution, engagement by engagement, and campaign by campaign, and to secure reasonably accurate statistics on Japan's economy and war production, plant by plant, and industry by industry. In addition, studies were conducted on Japan's over-all strategic plans and the background of her entry into the war, the internal discussions and negotiations leading to her acceptance of unconditional surrender, the course of health and morale among the civilian population, the effectiveness of the Japanese civilian defense organization, and the effects of the atomic bombs. Separate reports will be issued covering each phase of the study.

The Survey interrogated more than 700 Japanese military, government, and industrial officials. It also recovered and translated many documents which not only have been useful to the Survey, but also will furnish data valuable for other studies. Arrangements have been made to turn over the Survey's files to the Central Intelligence group, through which they will be available for further examination and distribution.

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THE CORPORATION AND ITS IMPORTANCE IN THE AIRCRAFT INDUSTRY

Introduction

The Hitachi Aircraft Co. (Hitachi Kokuki K K), producer of both engines and airframes, operated 5 plants. From January 1941 until the end of the war the company produced 13,571 aircraft engines of 14 types, representing 11.6 percent of all engines produced by Japanese manufacturers during that period. The airframes division produced 1,783 aircraft of 4 types, or 2.6 percent of Japanese aircraft produced from January 1941 through August 1945.

The corporation principally was concerned with the production of small engines for training aircraft, and also the assembly of trainer aircraft. Toward the end of the war attempts were made to bring Hitachi into the production of combat aircraft and combat aircraft engines, but the abrupt ending of the war found production of both in a relatively experimental status (Table 1).

TABLE 1.—*List of products, Hitachi Aircraft Co.*

AIRFRAMES

	Designation	Plant	Dates
K2Y2	Type 3 primary trainer.	Haneda	May 1939–Oct. 1940.
K5Y1	Willow type 93 intermediate trainer.	do	Dec. 1940–Dec. 1942.
			May 1943–Nov. 1944.
K9W1	Type 2 primary trainer.	do	Apr. 1943–Aug. 1943.
A6M5–K	Zeke trainer	Chiba	Apr. 1944–July 1945.
A6M5	Zeke fighter	do	(Planned only.)
P1Y1	Frances twin-engine bomber.	do	Do.

ENGINES

	Designation	Plant	Dates
Kinsei 43		Omori	Apr. 1942–Sept. 1943.
Tempu 11	(Ha-23 Model 11)	Omori	Sept. 1941–Oct. 1944.
		Chiba	Apr. 1945–June 1945.
Tempu 12	(Ha-23 Model 12)	Omori	Mar. 1942–Oct. 1942.
Tempu 15	(Ha-23 Model 15)	do	Apr. 1944–May 1945.
Tempu 21	(Ha-23 Model 21)	Omori	Mar. 1942–July 1945.
		Chiba	July 1944–July 1945.
Tempu 31	(Ha-23 Model 31)	Omori	Mar. 1944–Apr. 1945.
		Chiba	Nov. 1944–Apr. 1945.
Hatsukaze 11	(Ha-11 Model 11)	Omori	June 1941–Sept. 1943.
Tsu-11	(Hatsukaze 11 with jet)	Chiba	May 1945–July 1945.
Ha-12	(Ha-21 Model 11)	Tachikawa	May 1939–June 1944.
Ha-13	(Ha-23 Model 13)	do	May 1939–July 1943.
Ha-13KO	(Ha-23 Models 22, 23, 24).	do	May 1939–July 1945.
Ha-26	(Ha-31 Model 15)	do	Apr. 1942–July 1945.
Ha-42	(Ha-22 Model 17)	do	July 1943–Nov. 1943.
Ha-112	(Ha-33 Model 62)	do	June 1944–July 1945.
Ha-51		do	(Experimental only.)

The Hitachi Aircraft Co. was formed in May 1939 when it began operation of three plants purchased from the Hitachi Manufacturing Co. (Hitachi Seisakusho). The Hitachi Manufacturing Co. had acquired the three plants, Omori, Tachikawa, and Haneda, all located in the Tokyo suburbs, through a merger previously made with the Tokyo Gas and Electric Industries (Tokyo Gasu-Denki Kogyo K K). Haneda became an airframes plant, and Omori and Tachikawa started engine production.

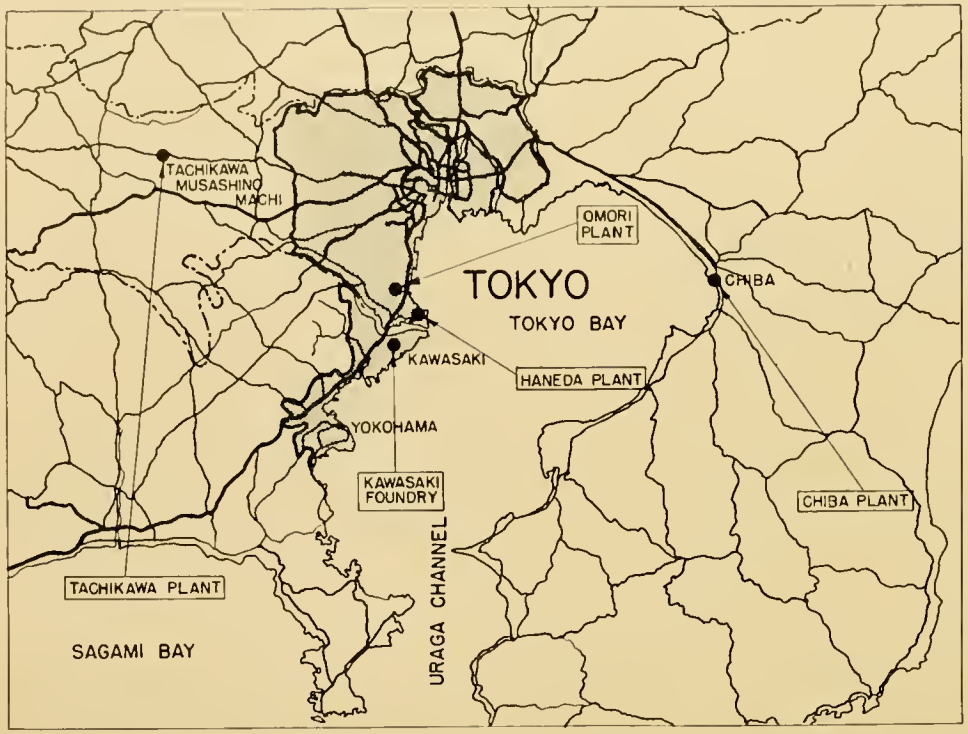
In July 1939 the company began construction of a new plant at Kawasaki which was to be devoted to the production of engine castings. Production began at this plant in August 1939.

In February 1941 the government ordered Hitachi to expand, and a site was selected about 2 miles southwest of the city of Chiba on Tokyo Bay. This plant began operation in April 1942, but until May 1944 production was limited to the manufacture of small parts for the Omori plant. After that date Chiba took over the greater share of Hitachi airframe production, reducing Haneda virtually to a feeder plant, and from July 1944 took over engine production from Omori in the same way. This expansion was related with the attempt to convert Hitachi to fighter and bomber production, and if plans had been carried out, Chiba would have become the largest Hitachi plant (Fig. 1).

When the Hitachi Aircraft Co. first began operating the three plants purchased from the Hitachi Manufacturing Co. all plants were manufacturing equipment for the Army. In July 1939, however, the Naval Ministry requested the services of the Haneda plant, which was then assigned to this Ministry. In October 1941 the Omori plant came under Navy supervision, and the Chiba plant from its inception produced equipment only for the Navy. The Tachikawa plant, largest engine producing plant of the company, remained under Army contract.

In the fall of 1943 the Hitachi Co. formulated plans to manufacture the twin-engine bomber P1Y1 (Frances). At that time Kurt Schmidt, a Heinkel engineer who had arrived in Japan by blockade runner during the summer, was assigned to the company by the Japanese Government.

LOCATION OF PLANTS



KEY TO PLANTS

NAME	SITE AREA (SQ. FT.)	BLDG. AREA (SQ. FT.)	MACHINE TOOLS	HAMMERING & SEWING MACHINE ETC.	EMPLOYEES (APPROX.)
CHIBA (AIRFRAMES)	19,915,324	1,809,279	255	507	12,000
CHIBA (ENGINES)	13,069,405	913,015	595	683	
TACHIKAWA (ENGINES)	21,339,418	1,540,443	858	918	14,000
OMORI (ENGINES)	500,582	244,899	354	449	4,500
HANEDA (AIRFRAMES)	351,005	192,021	46	62	2,500
KAWASAKI FOUNDRY	208,116	57,693	4	23	1,000
TOTAL	55,383,850	4,757,350	2,112	2,642	34,000

U.S. STRATEGIC BOMB SURVEY
HITACHI AIRCRAFT CO.
FIGURE 1

Schmidt established offices at the Chiba plant for the purpose of aiding plant engineers in establishing mass production assembly line techniques. The ideas advanced by Schmidt were well received, and sections of the Chiba plant were assigned to production of this new aircraft. Due to scarcity of building materials, the general confusion created by dispersal, and the rapid end of the war, the projected plans never materialized.

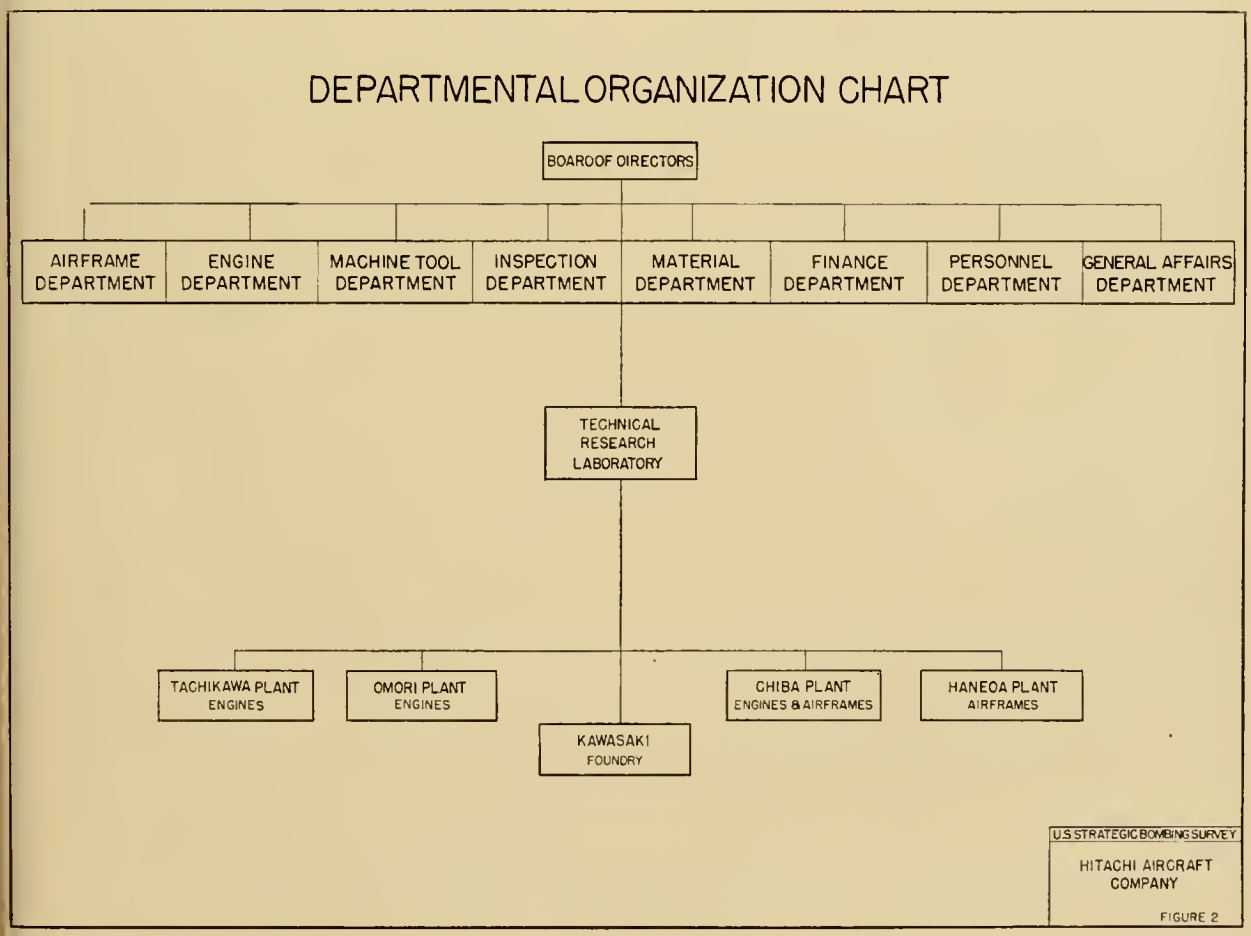
Since the company produced equipment for both the services, the Army and Navy each had inspectors and supervisors working with the company. Government inspectors performed routine inspection and acceptance duties but did not exercise financial duties at any time. Hitachi's earnest efforts to fulfill contracts removed all necessity for government operation, and no special interest was shown except by the Army in 1945 for the development of the Ha–51 engine and by Naval interest in developing the Chiba plant to assemble Frances.

Organization and operation

The main office of the Hitachi Aircraft Co. was located in Tokyo. The main office set policies affecting the operation and organization of the plants and made contracts with government agencies. General supervision of the company was handled by the board of directors through the various department heads (Fig. 2).

The responsibility for production of airframes and engines was placed on the particular departmental chief and the efficiency of any department was attributable to management by the individual in charge of the department.

Materials required by the five plants were computed by the department heads at meetings held with the directors. Previous to the meetings, individual plant managers supplied the department heads with the requirements of their particular plants. The plant managers of the two largest plants, Chiba and Tachikawa, were also directors of the company.



Within the company, the Tachikawa plant was the largest engine producer and the Chiba plant the largest producer of airframes. The Omori plant, from late 1942, had become a "feeder" plant for Chiba engine production, and production at Omori was reduced to the complete assembly of only one engine, the Tempu 15.

The Haneda plant had been engaged in the production of trainers (types 3, 14, and 93) up to late 1944. At that time it too became a feeder plant for Chiba and concentrated on the assembly of parts for the trainer A6M5K (Zeke) and for the fighter A6M5 (Zeke).

To aid in the assembly of airframes at the Chiba plant, the Haneda plant transferred many workers to this new company plant in November 1944. Similarly, the Omori plant had sent many trained workers to Chiba to organize the engine assembly lines.

The Kawasaki plant always remained purely a casting foundry supplying Tachikawa, Chiba, and Omori until it was destroyed by B-29s in an area attack on 15 April 1945. The plant produced both aluminum and magnesium alloy cylinder heads, reduction gear housings, crankcases, and casings for distributors, oil and fuel pumps, and carburetors.

The Hitachi Aircraft Co. reached peak employment in September 1944. In that month 34,277 people were employed, 13,896 at Tachikawa, 11,978 at Chiba, 4,576 at Omori, 2,852 at Haneda, and 975 at the Kawasaki foundry (fig. 3). From that time until February 1945 employment at Chiba continued to rise, reaching 14,467. Tachikawa employment remained fairly constant but employment at the 3 small plants dropped sharply. From February 1945 until the end of the war, air raids and dispersal caused a continued decline at all plants.

There appeared to be no set company policy on the use of single or multiple shifts of employees at the various plants. Policy changed at each location.

The Tachikawa plant used a single-shift basis (11 hours) until November 1943 and then changed to two 12-hour shifts when government orders for the Ha-13Ko and Ha-26 engines increased heavily at that time. In September 1944 the plant management again changed the system to three shifts of 8 hours each and continued on that basis until the end of the war.

The Chiba plant used different systems for each division. The airframe division worked on a single 9-hour shift basis until October 1944 then changed to two 12-hour shifts and worked until May 1945 on that basis. In May it reverted back to the single shift system. The engine division always used the two-shift basis.

The Omori engine plant used a single 8-hour shift until February 1944. From February until July 1944 two 10-hour shifts were used and from July 1944 until May 1945 the addition of student laborers prompted the management to convert to three 8-hour shifts. From May 1945 until the end of the war the plant reverted back to a single 8-hour shift.

Haneda and Kawasaki used the single-shift basis at all times.

The dispersal program

The Hitachi Aircraft Co. began plans for extensive dispersal in December 1944. Initial government orders to disperse were received at that time and the directors of the company assumed the responsibility for achieving the dispersal.

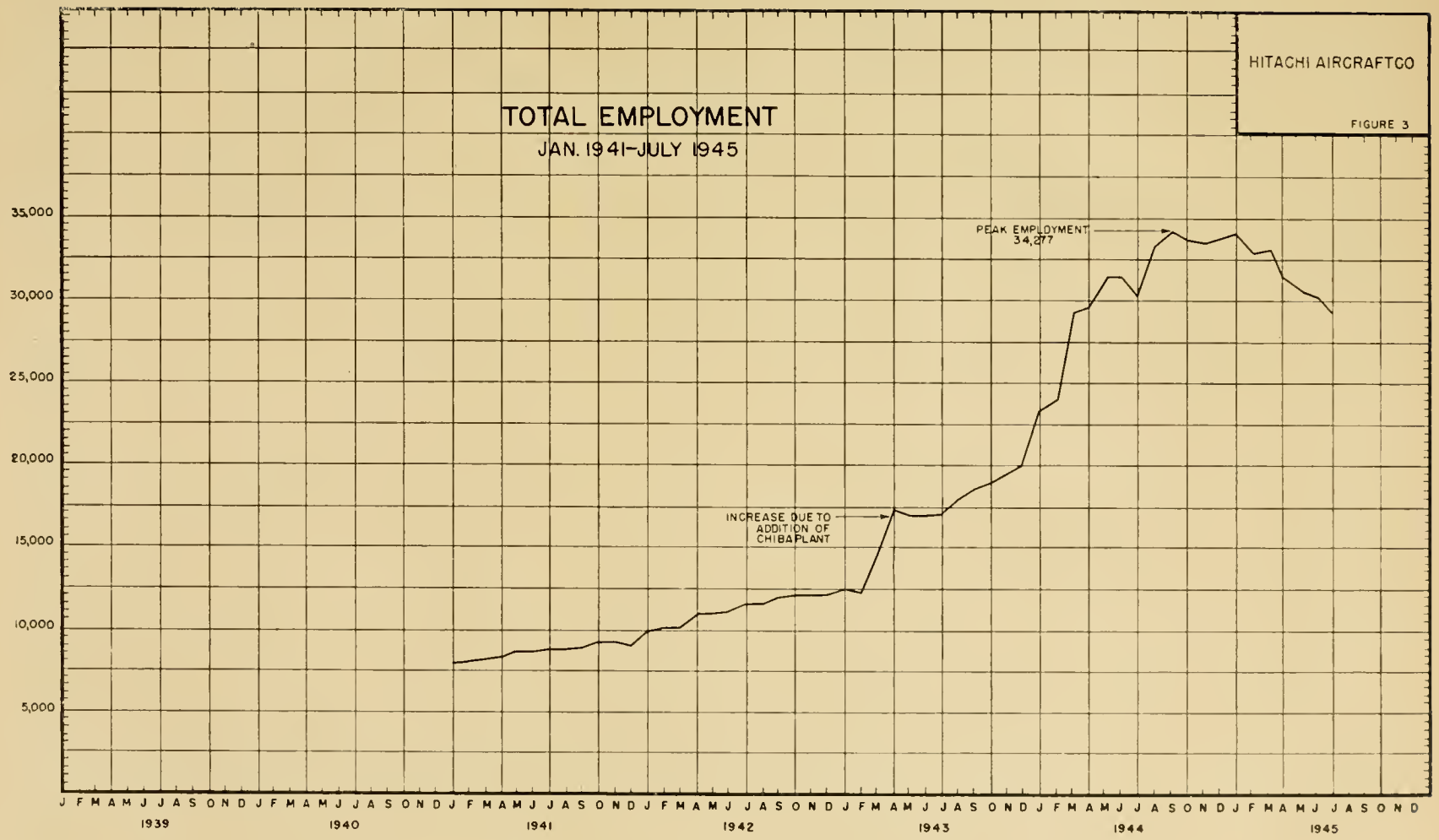
Individual plant managers actually chose the sites for dispersing their own activities. The two largest plants, Chiba and Tachikawa, chose mainly underground and semiunderground locations and used school buildings to a great extent (USSBS Aircraft Division, Reports VII–1 and VII–2).

Haneda and Omori planned to disperse to buildings near the parent plants in the hope that these small shops, although adjacent to the already bombed plants, would not be bombed again.

The Kawasaki foundry at first planned to continue production in buildings near the plant, but the increasing tempo of air attacks on the Kawasaki section forced the management to abandon this policy and to plan to utilize some of the sites selected by the Tachikawa engine plant.

Like other aircraft companies, the Hitachi Co stressed inadequate transportation as the chief problem in completing its dispersal plan. Many machine tools were spread throughout the countryside, abandoned by drayage companies that were forced to use trucks and oxcarts for other purposes in the summer of 1945. Particularly in the Oami section (a Chiba dispersal site) countless machines were to be seen on side roads and on railway sidings. Relatively slow progress of the Oami, Yokota, and Yashima tunnel systems was attributed to lack of labor and dynamite.

Labor conditions at the dispersal plants were said to be better since the employees were working under less mental strain and lost less time from their work due to alerts and attacks.


HITACHI AIRCRAFT CO
FIGURE 3
TOTAL EMPLOYMENT
JAN. 1941–JULY 1945
35,000
30,000
25,000
20,000
15,000
10,000
5,000
PEAK EMPLOYMENT
34,277
INCREASE DUE TO
ADDITION OF
CHIBA PLANT
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1939
1940
1941
1942
1943
1944
1945

Officials of the company found it difficult to estimate the effect of dispersal on company production, due to the fact that air attacks and alerts, as well as dispersal, caused losses in the same period. Coupled with the air attacks against other companies upon whom Hitachi was dependent for supplies, an assessment of relative loss due to dispersal was doubly hard to compute. A figure of 15 percent was expressed as "only an approximation."

The Oami tunnel system, chief dispersal site of the Chiba air-frame plant, was an extremely elaborate and well-planned unit. The entire excavated site contained an area of 483,720 square feet. It was approximately 40-percent completed, and the well-built tunnels and semiunderground shops promised to become one of the better dispersal plants in the Empire.

The Yashima underground factory, one of the planned dispersal sites of the Tachikawa plant, was to contain 248,500 square feet, which would have made it one of the biggest underground factories in the aircraft industry. At the end of the war the Yashima factory was approximately 20-percent completed.

THE AIR ATTACKS

Air attacks against the Hitachi Aircraft Co. plants caused a production loss of approximately 70 percent. Since all five plants were located in the highly industrialized Tokyo-Chiba region, attacks against the area were the greatest factor in Hitachi's production loss.

Damage to the Tachikawa plant was the most serious blow to the production capacity of the company (USSBS Aircraft Division, Report VII–2) since Tachikawa was its principal engine producer. The attacks against this plant on 17 February and 24 April 1945 rendered the plant completely inoperative. Physical damage to the plant was approximately 50 percent.

The Chiba plant was only superficially damaged by the three attacks made against it. Physical damage to the plant was negligible, only one building, a guardhouse, being damaged (USSBS Aircraft Division, Report No. VII-1).

The Haneda plant was damaged only once, in the Navy strike against the Haneda airfield on 17 February, and damage was negligible. Attacks against the area, however, were so intense that machines and assembly lines were removed to small buildings within the plant compound. This form of dispersal was effected in order to prevent a complete production break-down in the event the assembly building of the main plant was hit.

The Omori works at Kawasaki was damaged twice by Twentieth Air Force urban area attacks, namely, the Tokyo attack of 23 May and the Yokohama strike of 28 May. The latter damaged approximately 1,191,485 square feet of the plant. Like Haneda, the Omori plant had moved to nearby buildings, and production in the main plant was not greatly influenced.

Hitachi's Kawasaki foundry was almost completely destroyed by the Twentieth Air Force double attack of 15 April, against the Tokyo south urban area and the Kawasaki urban area.

From February until the end of the war the Tokyo-Chiba area was under attack many times, interrupting production because of the necessity of the workers leaving their jobs for air-raid shelters. Similarly, attacks against the city of Chiba caused a loss of many man-hours at the Chiba plant. In addition, since most of the dispersed shops of the Hitachi Co. were in the cities of Tokyo or Chiba, the attacks against the suburban areas of these cities often damaged Hitachi's dispersal locations.

PRODUCTION STATISTICS

Peak airframe production was reached in June 1944 when 95 aircraft (88 Willows and 7 Zeke trainers) were produced. This represented 100 percent of capacity for that month (Fig. 4 and appendix A).

Maximum engine production was in July 1944 when 575 engines were produced, of which the Ha–23 (Tempu series) engines represented about 55 percent of the total (Fig 5 and appendix A).

The Airframe Division

The Haneda plant was the original site for the company's airframe production, and produced the K2Y2 Type 3 primary trainer from May 1939 to October 1940 (never more than 7 a month), the K5Y1 Type 93 trainer (Willow) from December 1940 to November 1944 (peak production 88 in June 1944), and the K9W1 Type 14 trainer from April to August 1943, peak production being 15 in May. Willow production was suspended from December 1942 through April 1943. During 1944, however, emphasis began to be placed on production at Chiba, and Haneda production gradually became the fabrication of sections which were shipped to the Chiba plant for final assembly.

The Chiba plant was engaged from May 1944 to

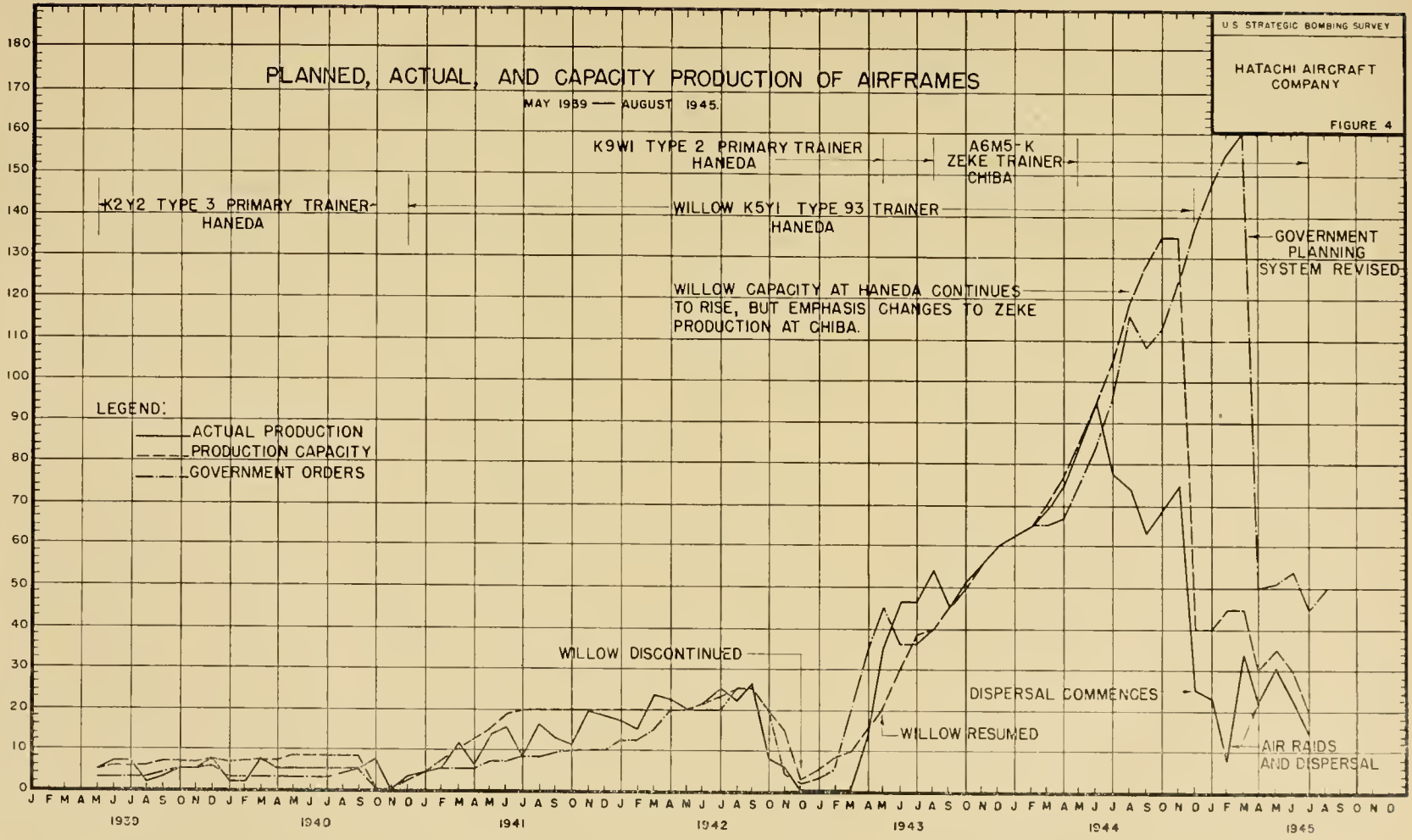

U.S. STRATEGIC BOMBING SURVEY
HATACHI AIRCRAFT COMPANY
FIGURE 4
PLANNED, ACTUAL, AND CAPACITY PRODUCTION OF AIRFRAMES
MAY 1939 — AUGUST 1945.
K9WI TYPE 2 PRIMARY TRAINER HANEDA
A6M5-K ZEKE TRAINER CHIBA
K2Y2 TYPE 3 PRIMARY TRAINER HANEDA
WILLOW K5Y1 TYPE 93 TRAINER HANEDA
GOVERNMENT PLANNING SYSTEM REVISED
WILLOW CAPACITY AT HANEDA CONTINUES TO RISE, BUT EMPHASIS CHANGES TO ZEKE PRODUCTION AT CHIBA.
LEGEND:
ACTUAL PRODUCTION
PRODUCTION CAPACITY
GOVERNMENT ORDERS
WILLOW DISCONTINUED
DISPERSAL COMMENCES
WILLOW RESUMED
AIR RAIDS AND DISPERSAL
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1939
1940
1941
1942
1943
1944
1945

FIGURE 5

the end of the war only in assembly of the A6M5–K Zeke trainer, reaching a peak of 34 in March 1945. It was at Chiba, also, that the A6M5 Zeke fighter and the P1Y1 bomber Frances were to have been produced. Buildings for the assembly of the latter were under construction, but dispersal plans greatly affected the construction of this aircraft, and while the Navy had ordered 145 completed in 1945, none of these were produced due to dispersal, air attack, and difficulties in filling orders for the Zeke trainer.

The Engine Division

Engine production was divided between Tachikawa, Omori, and Chiba, the former being the biggest producer. With the opening of the Chiba plant many engines formerly assembled at Omori were shifted for assembly to the Chiba plant and Omori continued to assemble only one engine of the Tempu Series, the Ha–23 Model 15.

Production at the Tachikawa plant (USSBS Aircraft Division, Report No. VII–2) reached its peak in March 1944 when it produced approximately 300 engines. During the last phase of the war (January 1945 through August 1945) much time at Tachikawa was devoted to making minor changes in Ha–23 Model 62 (Ha–112) and in developing the new 2,500 horsepower Ha–51, designed by a Hitachi engineer. Several of the Ha–51 type had been built by August 1945 although a plane for the engine had not yet been designed.

Chief bottlenecks in engine production were said to be inferior substitute materials, shortage and inferior grades of raw materials, the shortage of skilled employees since 1941, and air attacks and dispersal.

EVALUATION OF PRE-ATTACK INTELLIGENCE

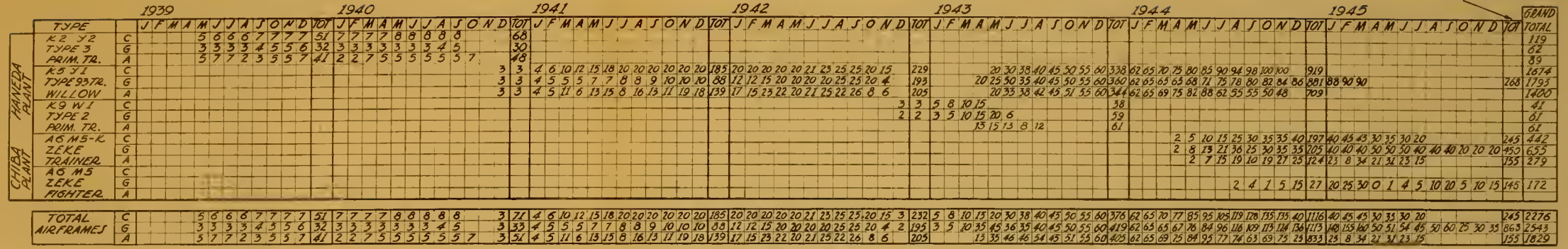
War Department Military Intelligence Service (G 2) did not publish any information on the Hitachi Aircraft Co.

PLANNED, ACTUAL, & CAPACITY PRODUCTION

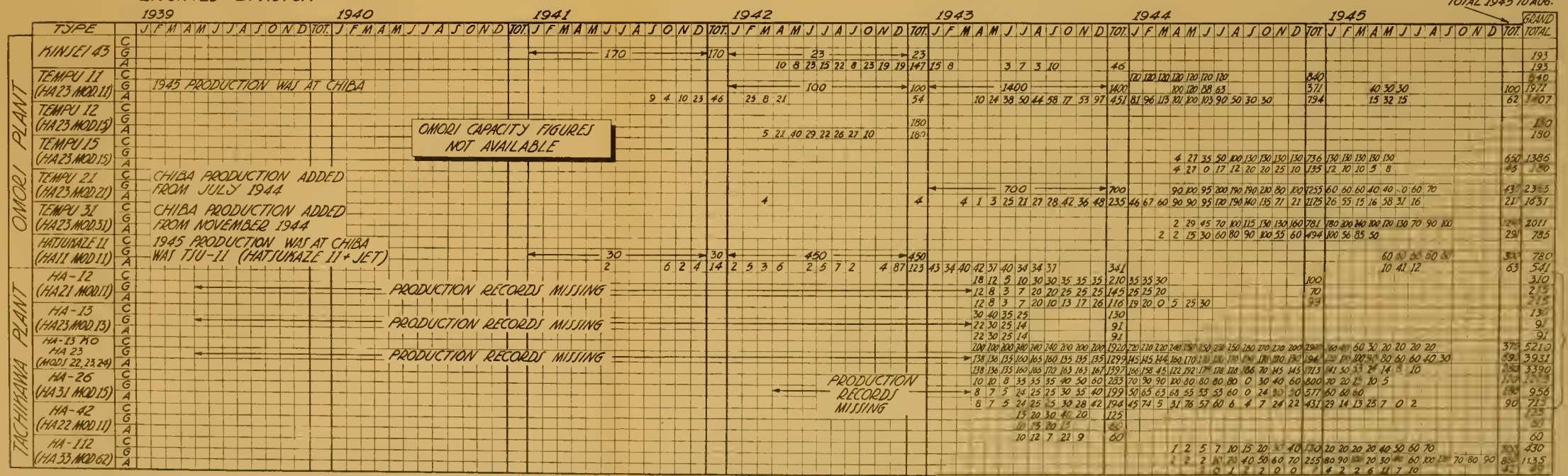
MAY 1939 — AUGUST 1945

HITACHI AIRCRAFT COMPANY

AIRFRAMES DIVISION



ENGINES DIVISION



C = PRODUCTION CAPACITY
G = GOVERNMENT ORDERS
A = ACTUAL PRODUCTION

GRAND TOTALS FROM APRIL 1943

EXCLUDING EARLY TACHIKAWA PRODUCTION

U.S STRATEGIC BOMBING SURVEY
HITACHI AIRCRAFT COMPANY
APPENDIX A

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CHIBA PLANT REPORT No. VII–1

(Airframes and Engines)

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THE PLANT AND ITS FUNCTION IN THE AIRCRAFT INDUSTRY

Introduction

Chiba, the newest and largest of the 4 plants of the Hitachi Aircraft Co. (Hitachi Kokuki K K), produced both engines and airframes. It began production in April 1942. The plant contained 41 buildings, with a floor area of approximately 2,209,838 square feet (Appendix A). It was engaged in the assembly of the A6M5K Zeke trainer, the Tempu 11, Tempu 21, and Tempu 31 engines, and planned to assemble the bomber P1Y1 (Frances) and the fighter A6M5 (Zeke).

The Chiba plant was located on reclaimed land about 2 miles south of the city of Chiba, on Tokyo Bay. Construction of the plant began in February 1941 and was completed in April 1942 (Photos 1, 2, 3, and 4). The period from April 1942 to July 1944 was devoted to organizing the plant, training employees, setting up machine shops, installing production lines, and to manufacturing small parts for the Omori plant, another Hitachi plant located in the Tokyo suburbs. The first aircraft was built in July 1944, and the first engines, Tempu 21's, were completed in August 1944.

The plant was divided roughly in half, the northern part used for engine, and the southern part for airframe assembly, with a combined floor area of 1,671,735 square feet. This figure excludes an office, dining hall, repair shop, and a projected store room, machine shop, and sheet-metal shop which were the initial buildings of a new addition being constructed for the assembly of Frances. The entire area south of buildings 16 and 23 was to be devoted to work on this aircraft, and new land was to be reclaimed at the southwest corner of the plant on which to construct additional buildings. It had been planned to begin assembly of Frances in February 1946, but this did not allow for the effects of air attack and dispersal.

The Hitachi Corporation received instructions from the Naval Air Board in November 1938 to expand their facilities, and began the search for a new site at that time. In November 1940, it was decided to reclaim the land south of Chiba, and a contract was made between the Hitachi corporation and the Chiba city office. Actual work involved in reclaiming the land was not started until February 1941, and in October Hitachi received permission from the governor of Chiba prefecture to lay the foundations of the plant.

Erection of plant buildings began in November 1941. In April 1942 the Naval Branch ordered Hitachi to plan for expansion over original buildings for the assembly of the Zeke fighter, and in October 1943 the company was ordered to construct the additional buildings for the assembly of Frances. The physical construction of the plant was financed by the Hitachi Holding Co.

All products of the Chiba plant were produced for the Navy. Production of the A6M5K Zeke trainer began in August 1944 (Photo 5), that of the A6M5 Zeke fighter was planned for August 1945, and that of the P1Y1 bomber (Frances) for February 1946. Production of the Tempu 21 engine began in July 1944, of the Tempu 31 in November 1944, of the Tempu 11 in April 1945, and of the Tsu 11 in May 1945. In the case of the Tsu 11, Chiba served as a modification center where the Italian Campini type jet unit was produced and fitted to Hatsukaze 11 engines sent in by the Navy, the resulting engine being redesignated Tsu 11 (Photos 6, 7, and 8).

NOTE.—The Tsu 11 engine was intended for the Oka 22 (Baka) suicide plane, which differed from Oka 11 in that it was jet-propelled instead of rocket-propelled.

Plant organization and operation

The chief of the Chiba plant, Kajiro Ideta, was also an executive director of the corporation. Immediate responsibility at the plant fell upon Yusaku Fukada, head of the airframe factory, and Hiroshi Moroi, chief of the engine factory (appendix B).

Both divisions of the plant were organized for mass production. The airframe division in particular was modeled after the Nakajima plant at Koizumi. The front, center, and rear fuselage assemblies were placed on a wooden-rail system about 4 feet above the floor, and were staged along the rail until they rolled off completely assembled and ready to be transported by barge to the

Photo 1—CHIBA PLANT.—General view of the buildings of the engine division photographed from the administration building.

Photo 2—CHIBA PLANT.—General view of the buildings of the airframe division photographed from the administration building. Note the dismantled buildings that were being removed to dispersal sites.

Photo 3—CHIBA PLANT.—Newly constructed engine test cells at the Chiba plant (four stands).

Photo 4—CHIBA PLANT.—Interior view of the engine test cells.

Photo 5—CHIBA PLANT.—Side view of the Zeke trainer manufactured by the Chiba plant showing the installation of an auxiliary fin necessary to reduce flutter in the tail section caused by the addition of after cockpit and the added "greenhouse" on that type trainer.

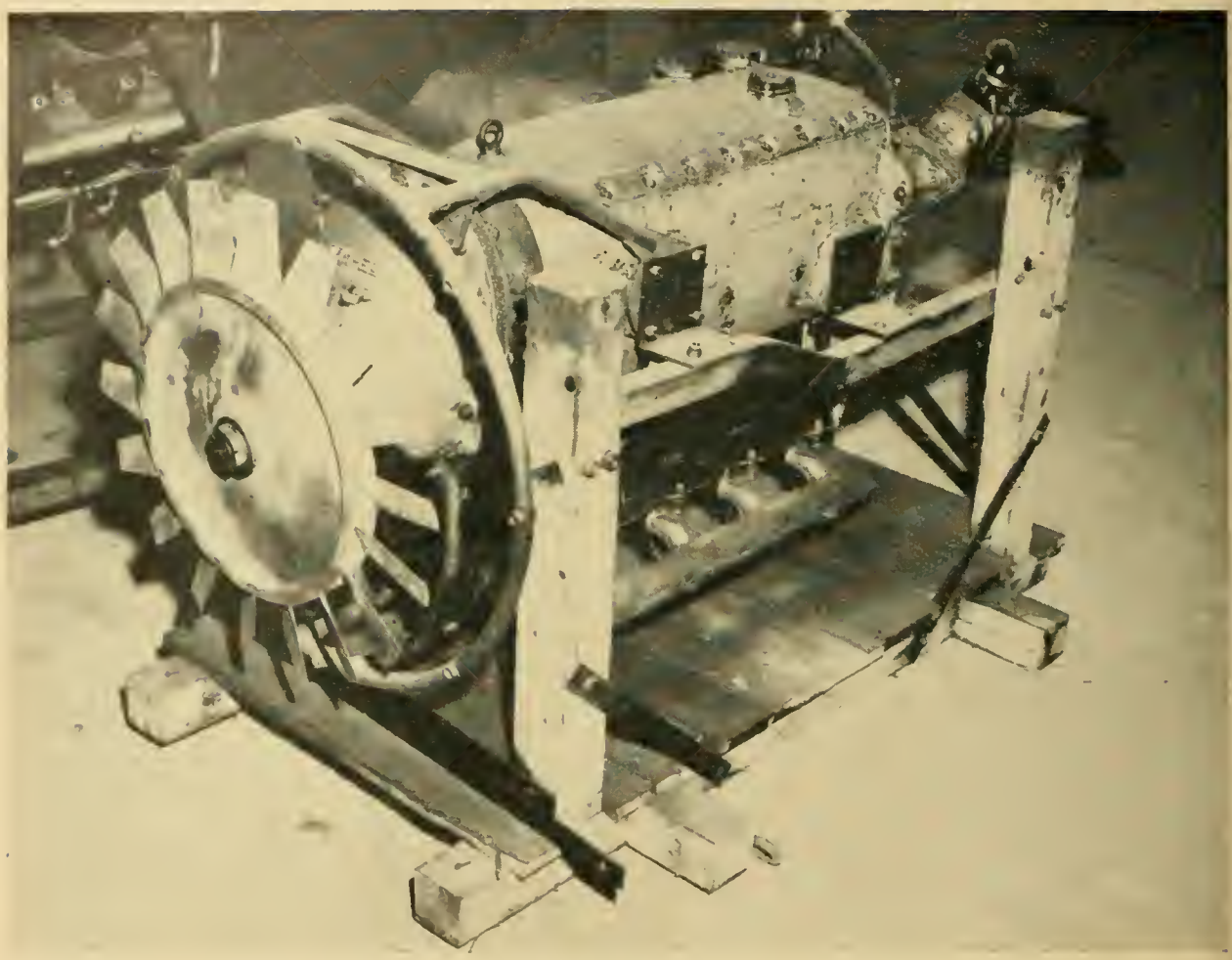


Photo 6—CHIBA PLANT.—Photograph of additional impeller ring added to Ha-11 engine for conversion to the Tsu 11 type, for installation in Oka 22 (Baka) suicide plane.

Photo 7—CHIBA PLANT.—Front view of the Campini type turbine that was added to the Ha-11 engine in order to construct the Tsu 11.

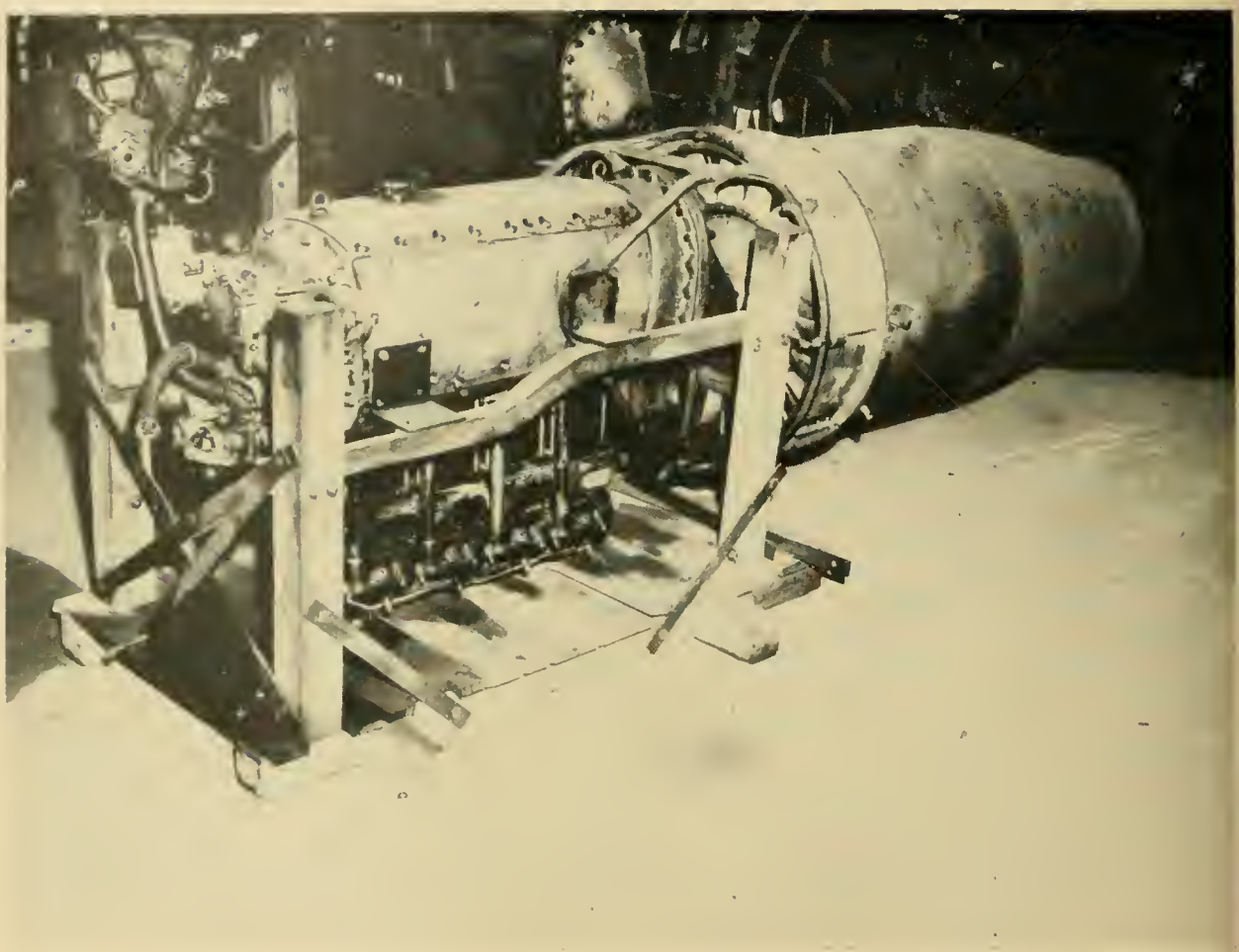
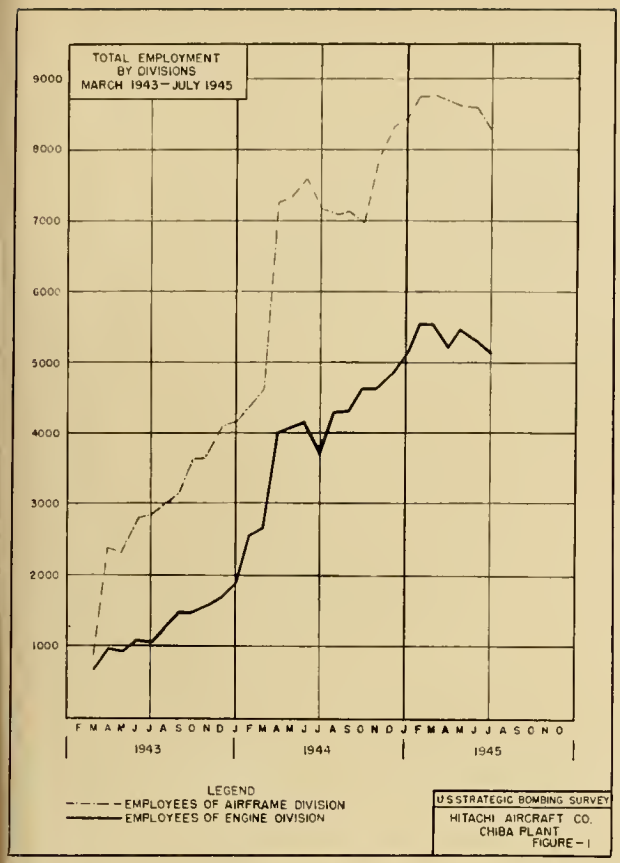


Photo 8—CHIBA PLANT.—General view of the assembled Tsu 11 engine.



Kisarazu or other naval air facility. Only one such rail system was completed. Another assembly line was in operation adjacent to it, using a similar procedure without the rail. An abundance of overhead chain falls was available but there were no conveyor systems.

Of 16 operations preceding final assembly, slightly more than 50 percent were performed by subcontractors, and some of these were entirely in subcontractor's hands (Appendix C).

Engine assembly was organized in a similar manner, using production line technique (Appendix D). Hitachi officials considered the Chiba plant, both airframe and engine divisions, to be among the best planned in the Empire, combining many of the better features of other plants operating under naval contract.

Peak employment was in March 1945 for both the airframe division (8,795 workers) and the engine division (5,565 workers) (Fig. 1 and Appendix E, parts 1 and 2). Students were employed by the plant from March 1944 until the end of the war, and the proportion increased until it reached 30 percent in July 1945. The apprentice school at the Chiba plant was thought excellent by Hitachi officials, and the work of student labor completely acceptable. Soldier labor was never used.

The plant operated on a single-shift system until August 1944, when a two-shift system was installed and was continued to the end of the war. The first shift worked from 0800 to 2000, and the second from 2000 to 0800 the following morning. About 85 percent of the employees were on the first shift; the second shift was composed entirely of men workers. During the night shift only a few shops operated, and the assembly shops of both divisions were shut down.

Supply of materials and components

As the central plant of the Hitachi Corporation, Chiba received most of the parts needed for assembly of both airframes and engines from other Hitachi plants and from subcontractors (Appendix F). From raw materials received Chiba produced many parts, including gears, cams, jigs, and various small steel and light metal parts.

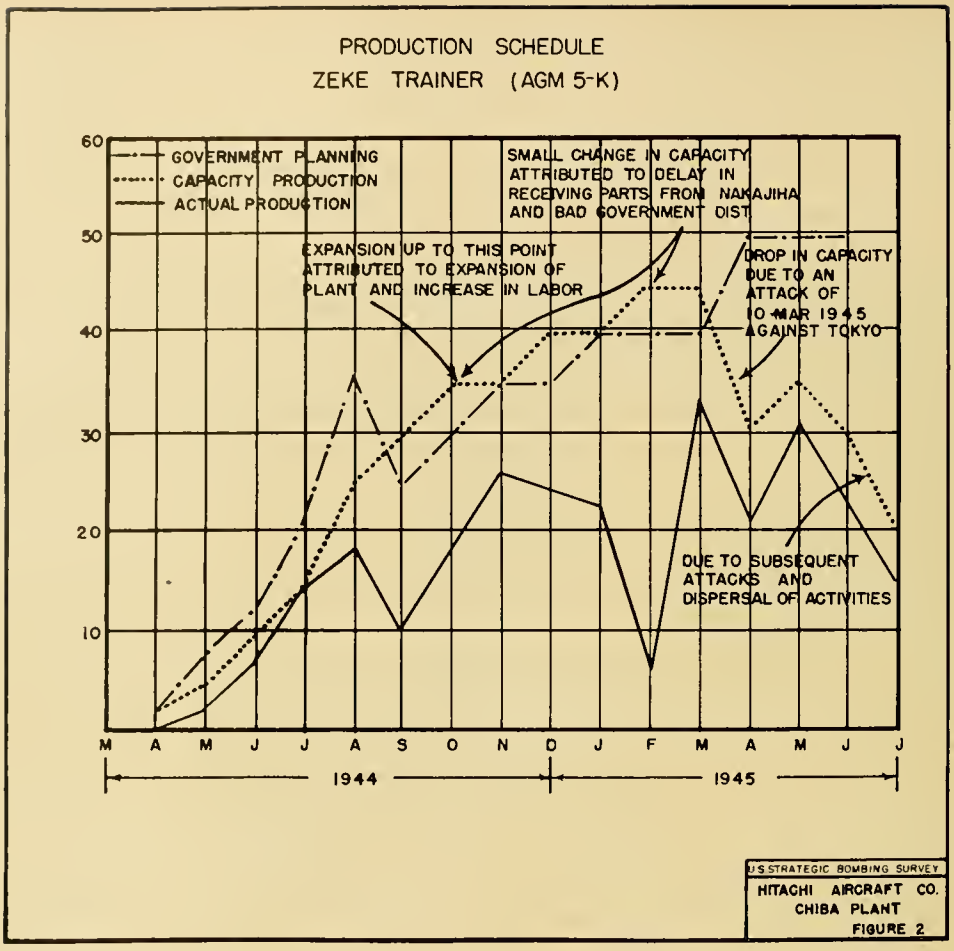
Shortages of raw materials and component parts often delayed production and was the chief reason of Chiba's inability to meet government requests. During the period April 1944 to August 1945, raw materials received averaged 64.4 percent (airframe division) and 49.8 (engine division) of the amounts ordered (Appendix G). In the same period receipts of components averaged 60.8 percent of orders (Appendix H). Defaults by Nakajima in supplying wing and tail assemblies were cited by plant officials as an especially serious shortage.

Production statistics

From April 1944 until the end of the war production at this plant did not come up to either the management's expectations nor the government's desires. Plant officials blamed this shortcoming upon poor government planning and upon defaults in commitments from subcontractors.

During that period, the government (Navy) ordered 555 airframe units and 2,730 engines. During that same time, the estimated plant capacity was 442 airframes and 2,110 engines. But actual production was only 279 airframes (63 percent of capacity) and 113 engines (53 percent of capacity) (Appendix I and Figs. 2, 3, 4, and 5).

Peak production of airframes occurred in March of 1945 when 34 units were turned out. Engine production hit peaks in November 1944 and


PRODUCTION SCHEDULE
ZEKE TRAINER (AGM 5-K)
GOVERNMENT PLANNING
CAPACITY PRODUCTION
ACTUAL PRODUCTION
SMALL CHANGE IN CAPACITY ATTRIBUTED TO DELAY IN RECEIVING PARTS FROM NAKAJIHA AND BAD GOVERNMENT DIST
EXPANSION UP TO THIS POINT ATTRIBUTED TO EXPANSION OF PLANT AND INCREASE IN LABOR
DROP IN CAPACITY DUE TO AN ATTACK OF 10 MAR 1945 AGAINST TOKYO
DUE TO SUBSEQUENT ATTACKS AND DISPERSAL OF ACTIVITIES
60
50
40
30
20
10
M A M J J A S O N D J F M A M J J
1944
1945
U.S STRATEGIC BOMBING SURVEY
HITACHI AIRCRAFT CO.
CHIBA PLANT
FIGURE 2

January 1945, when a rate of 126 units per month was attained.

Rebuilding and repair of airplanes and/or engines

No rebuilding or repairing of airplanes or engines was done at Chiba. The production of Tsu 11 engines, however, was in reality a modification. Ha–11 engines which had originally been manufactured elsewhere were modified into the Tsu 11 engine.

Diversion of plant capacity and effort to experimental aircraft and engines

The Chiba plant never engaged in experimental work or research.

ATTACK DATA

Intelligence data:

Date and hour of attack	10 June 1945, 2245.
Type of attack	Direct.
Time on target	1 minute.
Attacking unit	Twentieth Air Force.
Altitude	16,500 feet.
Number of aircraft over target	27.

ATTACK DATA—Continued

Intelligence data—Continued

HE-number, weight, and type	144 tons (577 X AN-M64 GP's).
HE-fuzing	1/100 nose, ND tail.
IB-number, weight and type	None.

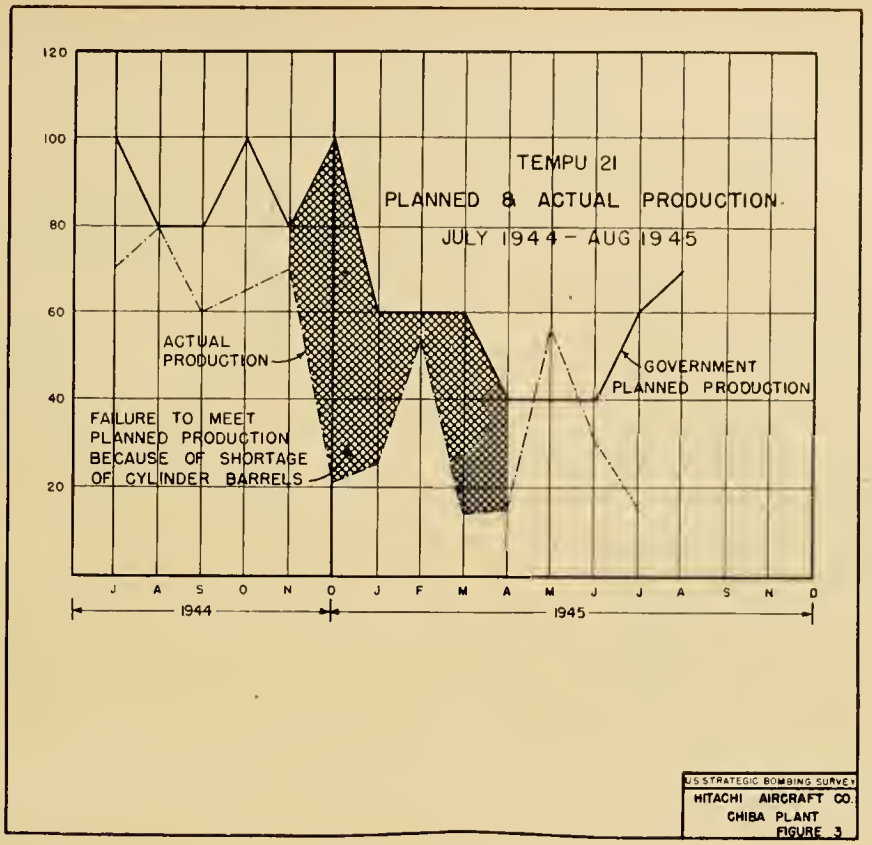
On-the-ground findings:

HE-number in plant area	55.
HE-number of building hits.	None.
HE-number of UXB	None.

EFFECTS OF BOMBING

The air attacks

Although the plant suffered 3 attacks, only light damage was sustained. A strike by Navy carrier-based planes against vessels at Chiba on 8 May 1945 spilled over onto the plant but resulted in almost no damage. In the Twentieth Air Force B–29 raid of 10 June, 3,000 square feet of the office building of the airframe division (Photos 9 and 10), 3,000 square feet of an airframe dis-



persal plant at the prefectural girls' high school in Chiba, and 5,500 square feet of a dispersed engine plant in the Chiba girls' normal school were damaged. In the Twentieth Air Force raid on the Chiba urban area, 7 July 1945, incendiary bombs damaged 15 machine tools and 2,100 square feet of the airframes dispersal plant in the Chiba prefectural girls' high school, 50 machine tools and 5,000 square feet of airframe dispersal buildings in Chiba belonging to the Engineering Department of Tokyo Imperial University, 850 square feet of the engine dispersal plant at the municipal girls' high school, 1 machine tool and 4,000 square feet of the engine dispersal plant at the prefectural technical school, and 1,000 square feet of the gas works at Chiba plant itself. Many machine tools, by this time, had been removed to dispersal locations, and none of the buildings housing machine tools at the parent plant, were damaged (Appendix J).

Production losses, as direct results of air attacks, was small (Fig. 6). The 8 May attack caused a loss of about 5 percent, or one airframe, and no engines. The 10 June attack did not affect airframe production, but caused a loss of about 10 percent, or 26 units of engine capacity. The 7 July urban area attack reduced airframe production 15 percent, from which loss it did not recover. In addition it brought engine capacity down an additional 4 percent loss for about 2 weeks, but reduced actual assembly by 44 percent. Recovery, however, was rapid.

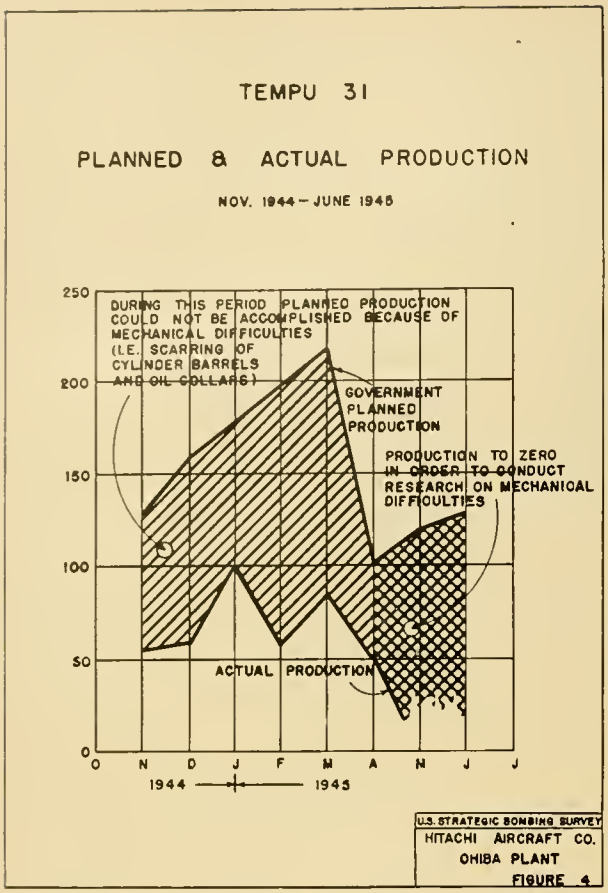
Countermeasures taken at the plant against attacks

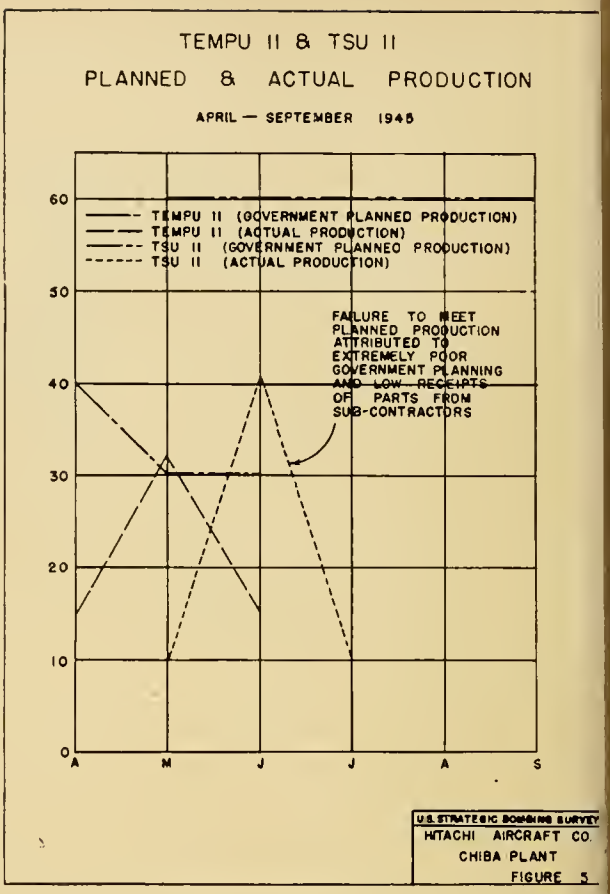
There was nothing unusual in the air-raid precaution system. A defense corps of some 250 persons was organized in April 1943 but was reduced to a few members in June 1945, when it was decided that little could be gained by risking the members of the corps.

Trenches were dug throughout the area and some of these were later covered with crude and inadequate "bomb proofing" consisting of wooden ceilings covered with loose soil (Photo 11).

Some buildings were camouflaged and others, being of inflammable wood construction, were dismantled (Photo 2).

Fire-fighting facilities consisted of 45 water tanks, 7 gas-engine pumps, and 80 hand pumps.





As none of the direct attacks on the main plant were very effective, the practical value of the precautions cannot be accurately judged, but it seems improbable that much could have been accomplished in the event of an accurate and effective attack on the main plant.

Interruption to production due to alerts

Although physical damage to the plant was negligible, interruptions, caused by air-raid warnings, were a serious obstacle to production. The Tokyo industrial area, which included Chiba, was a target for frequent attacks and the plant was warned whenever Allied air and naval forces were in the vicinity. As a result, time loss due to alerts in July 1945 exceeded time spent in production (Fig. 7).

Interruptions to production due to area attacks

The principal effect of area attacks was the increase in absenteeism. Whenever planes were reported in the area the factory was warned, and workers left in large numbers and were slow in returning. If the homes of workers were destroyed or damaged, they took time off to find places to live or to repair damages.

Secondary effects were the disruption of transportation facilities and shipping schedules. This resulted in accumulation of finished engines awaiting shipment to users (Photo 12).

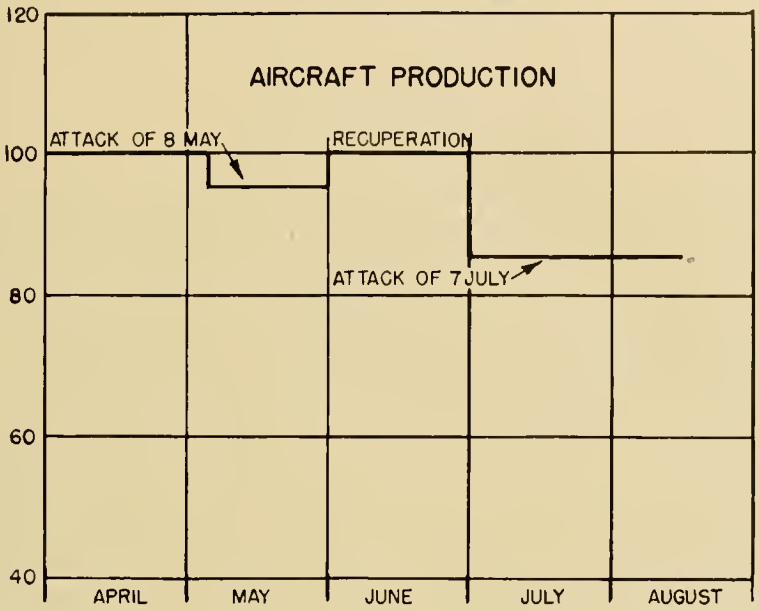
Interruptions to supplies

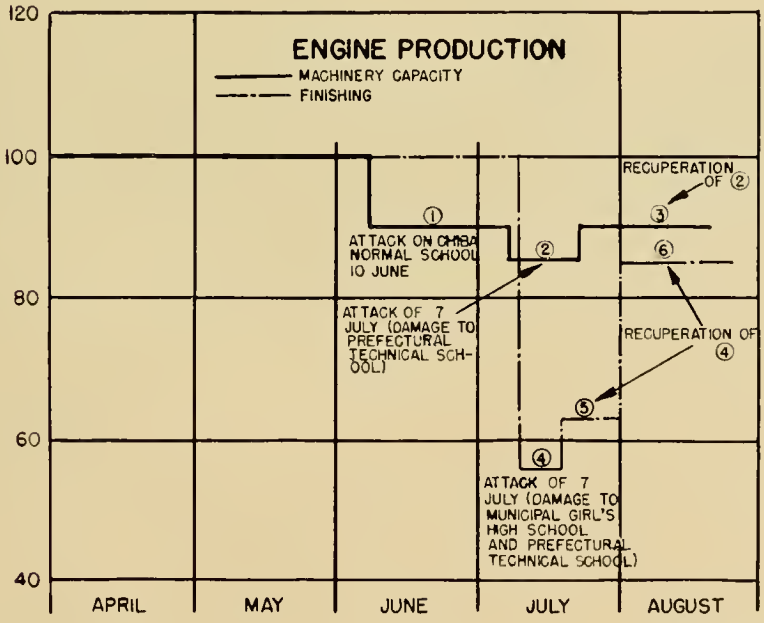
Air attacks had a serious effect on receipts of materials and components. Engine receipts from Kisarazu were very low in April, May, and June 1945 because of interruptions in supply from Nakajima. Propeller receipts from Sumitomo were also seriously reduced due to attacks on the Sumitomo plant at Kanzaki.

The supply of instruments of all types was seriously curtailed in July, while special steel tubing, bars, and light alloy metals of all types were in extremely critical shortage because of attacks against Sumitomo's Amagasaki plant, Mitsubishi's steel plant at Fukagawa, and the general attacks against the metal industries of Kobe.

Attempts to find new sources of supply were unsuccessful since small factories were affected by area raids and demands of other manufacturers were equally pressing.

INTERRUPTION IN PRODUCTION DUE TO AIR ATTACKS





U S STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT CO.
CHIBA PLANT

FIGURE 6

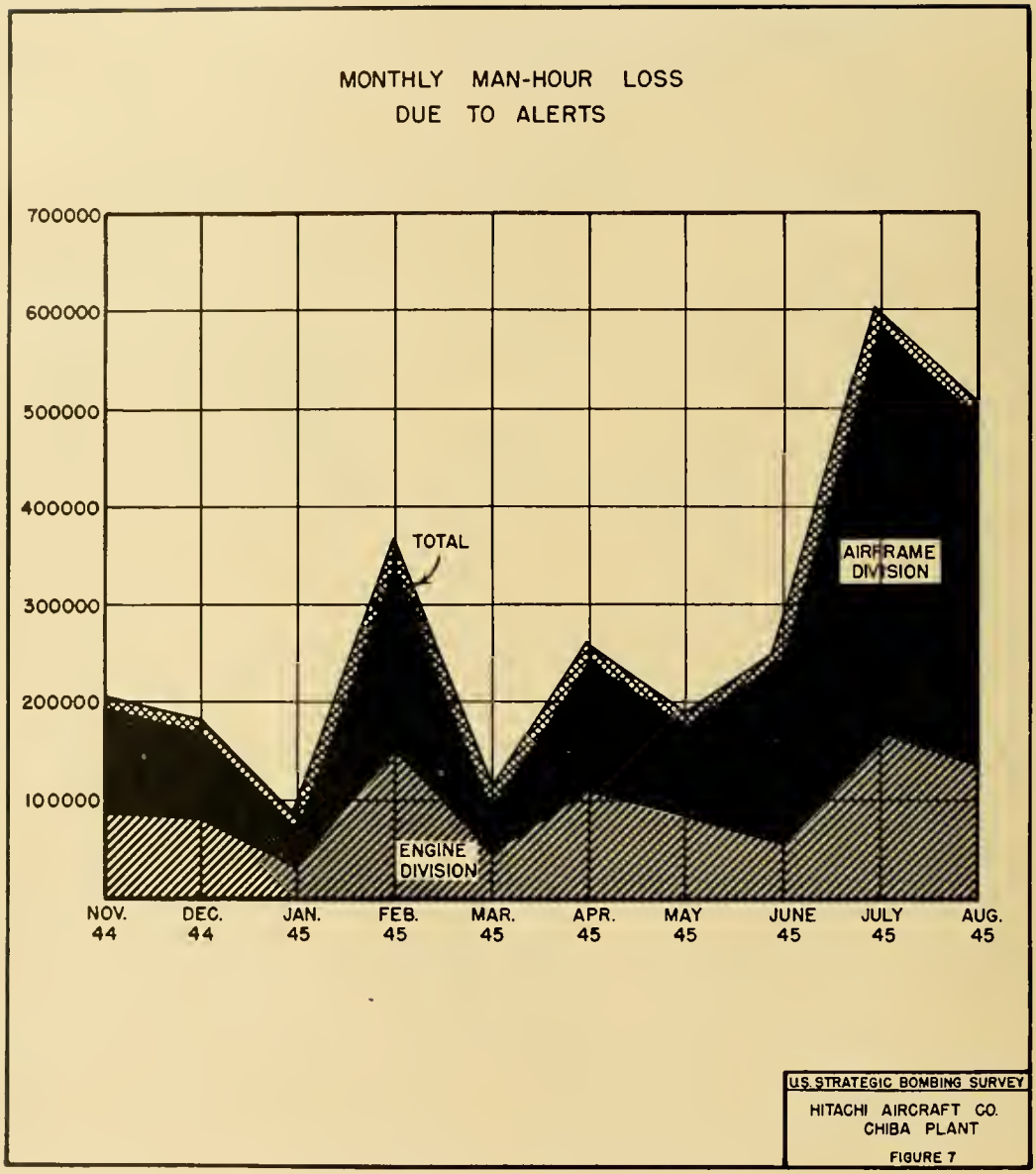

MONTHLY MAN-HOUR LOSS
DUE TO ALERTS
700000
600000
500000
400000
300000
200000
100000
TOTAL
AIRFRAME DIVISION
ENGINE DIVISION
NOV. 44
DEC. 44
JAN. 45
FEB. 45
MAR. 45
APR. 45
MAY 45
JUNE 45
JULY 45
AUG. 45
U.S. STRATEGIC BOMBING SURVEY
HITACHI AIRCRAFT CO.
CHIBA PLANT
FIGURE 7

Photo 9—CHIBA PLANT.—Photograph of bomb crater from 500-pound bomb dropped in the attack of 10 June 1945.

Photo 10—CHIBA PLANT.—Damaged building destroyed during the air attack of 10 June 1945. Damage occurred from a direct hit by a 500-pound bomb. This was the only serious damage to the plant by the attack and did not influence production since the building was used as a guard station.

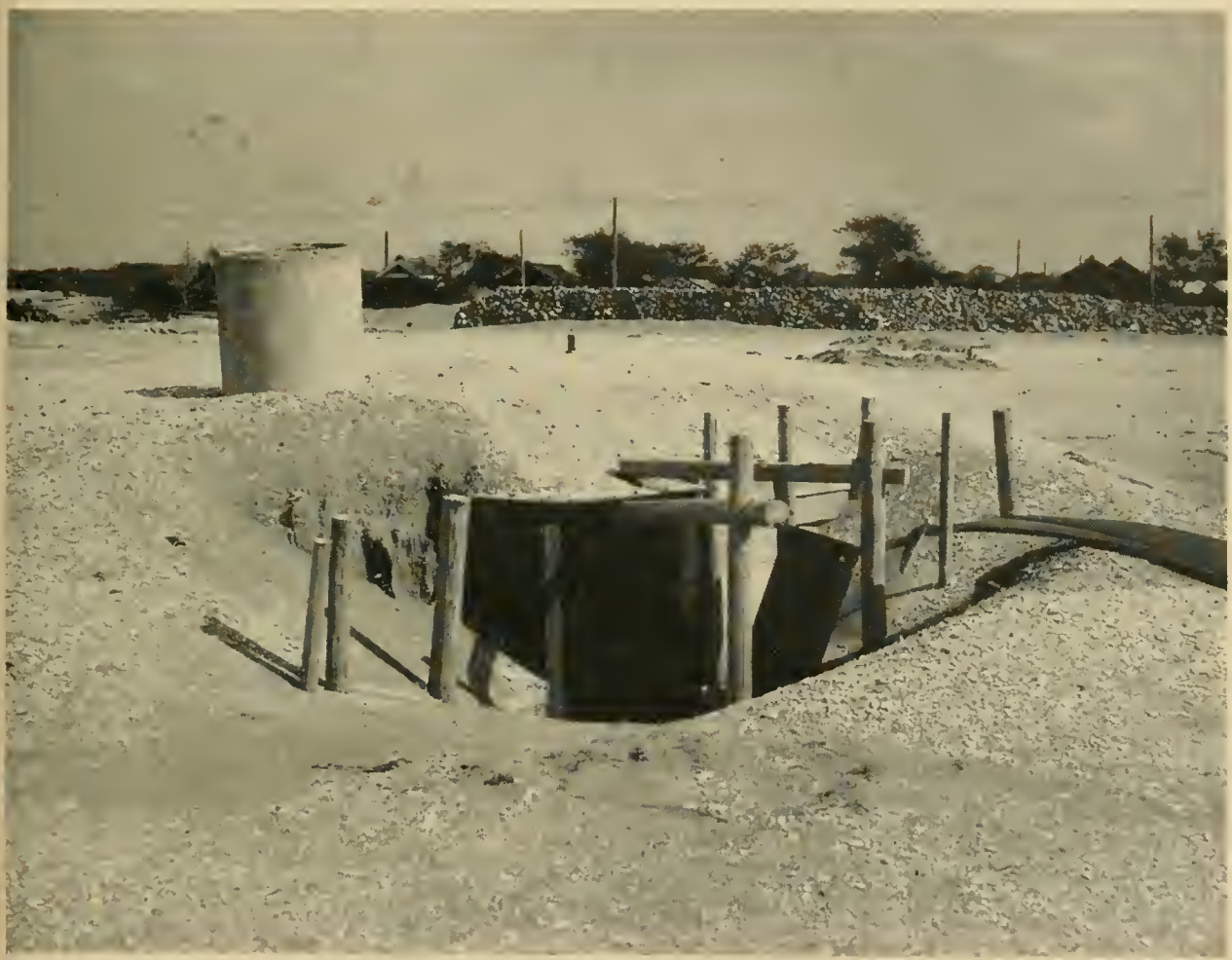


Photo 11—CHIBA PLANT.—Photograph of earthed-over shelter used by the plant as the headquarters of the air-raid defense force. All personnel shelters at the plant were of similar construction and appeared to be completely inadequate.

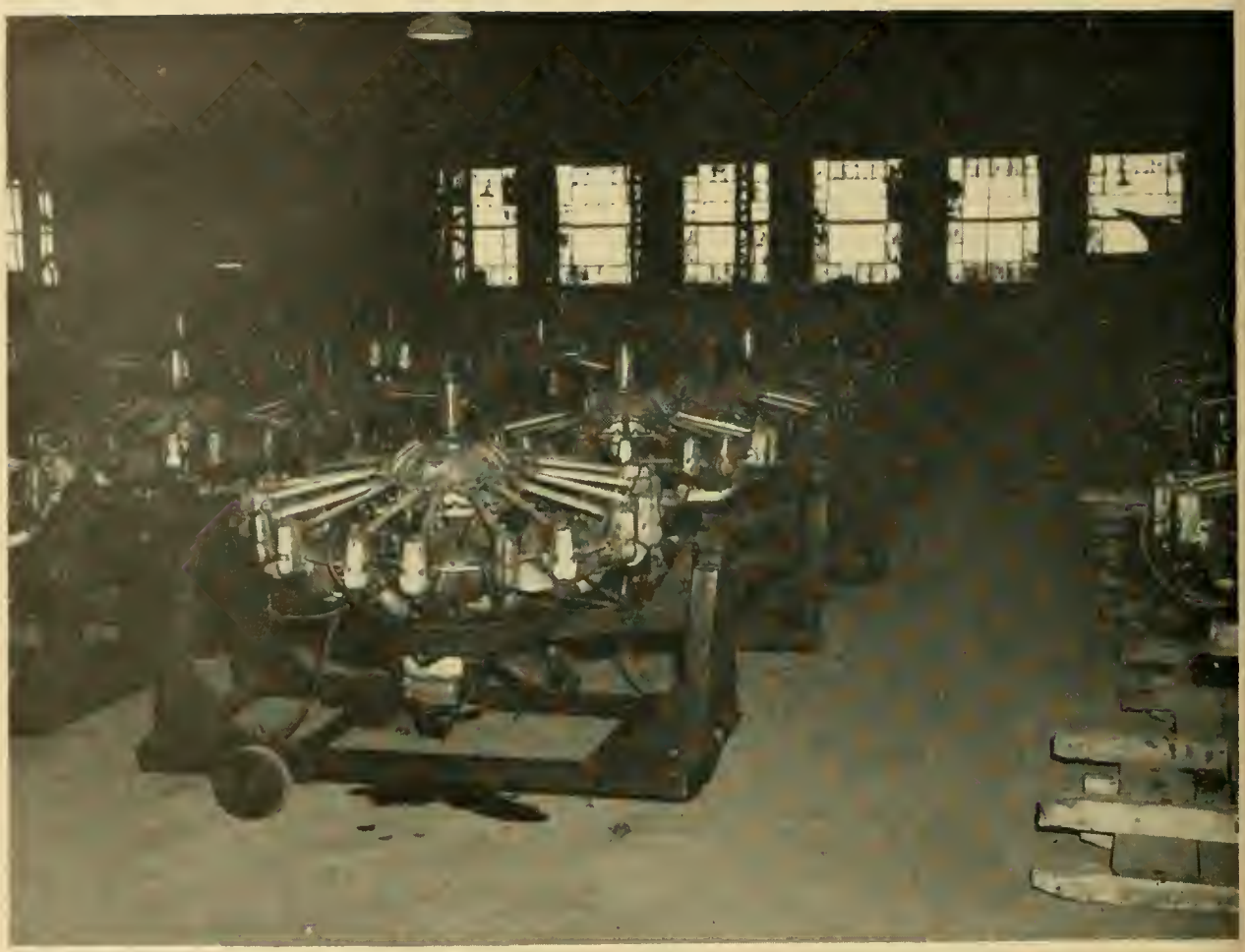


Photo 12—CHIBA PLANT.—View of interior of the main engine assembly shop showing the great number of Tempu 21 engines that were awaiting shipment.

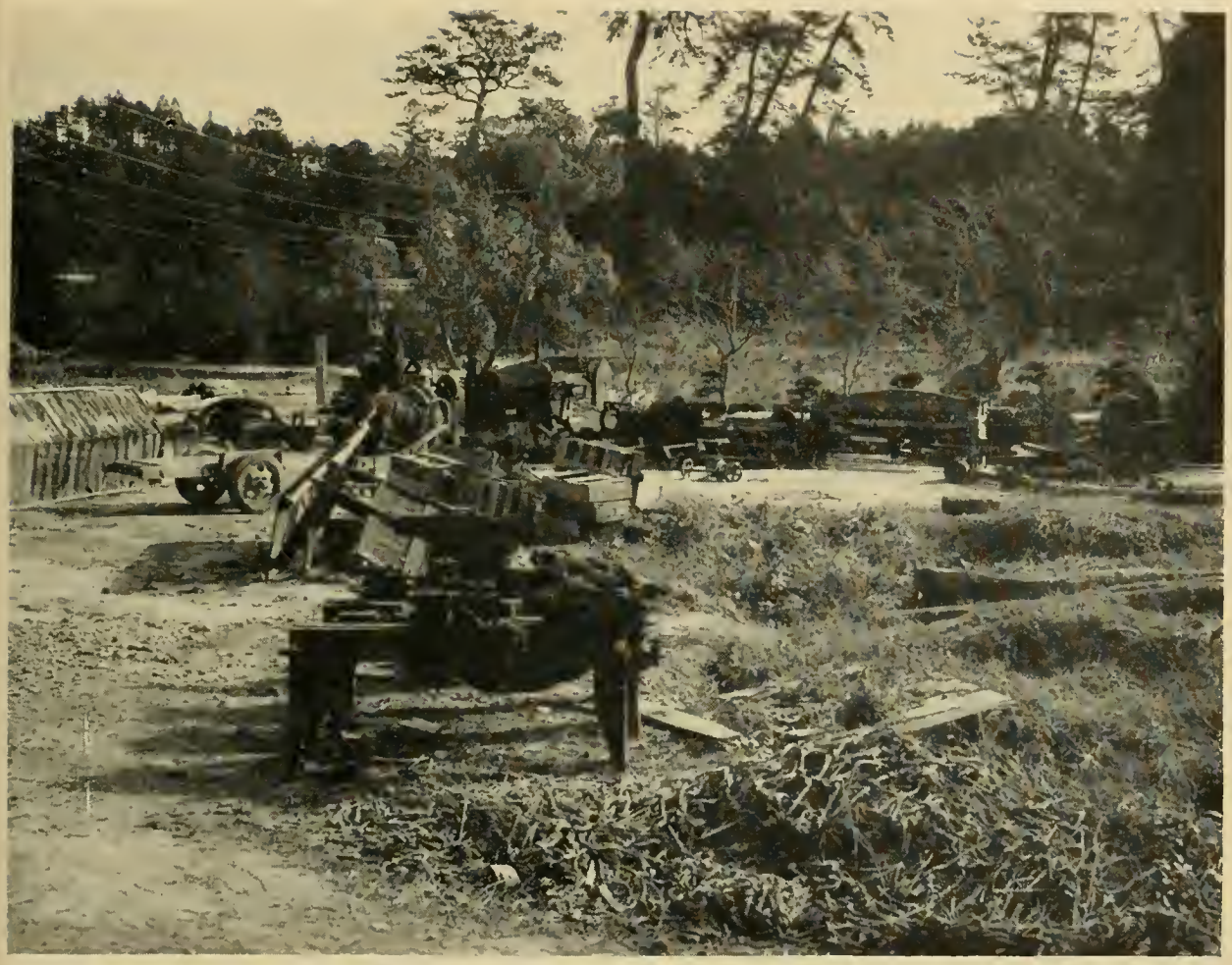


Photo 13—CHIBA PLANT.—Photograph of abandoned machinery resulting from the hurried dispersal program of the Chiba plant. Oami area of Chiba Peninsula.

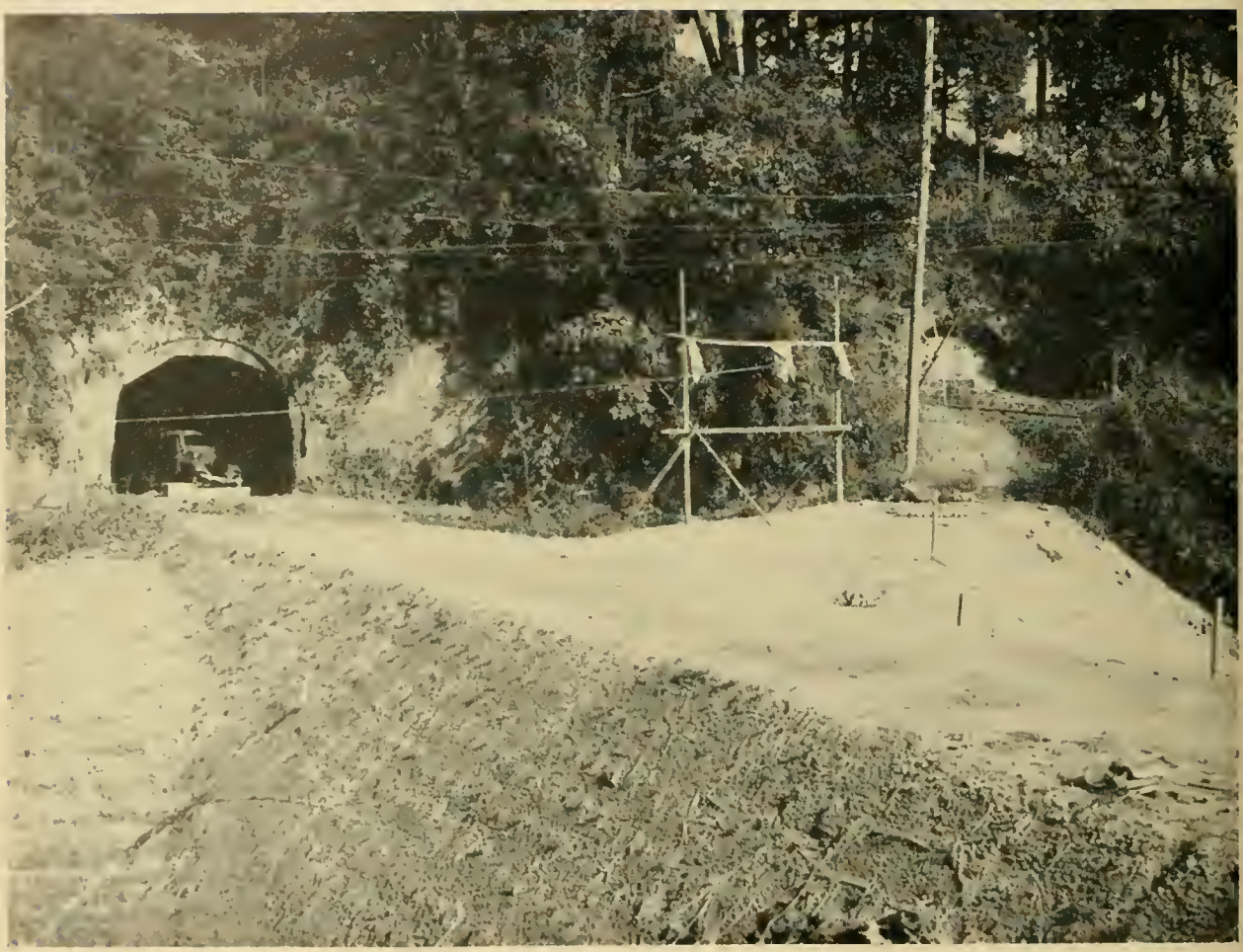


Photo 14—CHIBA PLANT.—Photograph of the entrances to tunnels Nos. 4 and 5 of the Oami tunnel system.

Photo 15—CHIBA PLANT.—Photograph of machinery installations in tunnel No. 1 of the Oami tunnel system.

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Photo 16—CHIBA PLANT.—One of many semiunderground shops located in the Oami area. Close inspection reveals the ventilator on top of the earthed-over shop and the entrance to the shop may be seen to the left of the photo.

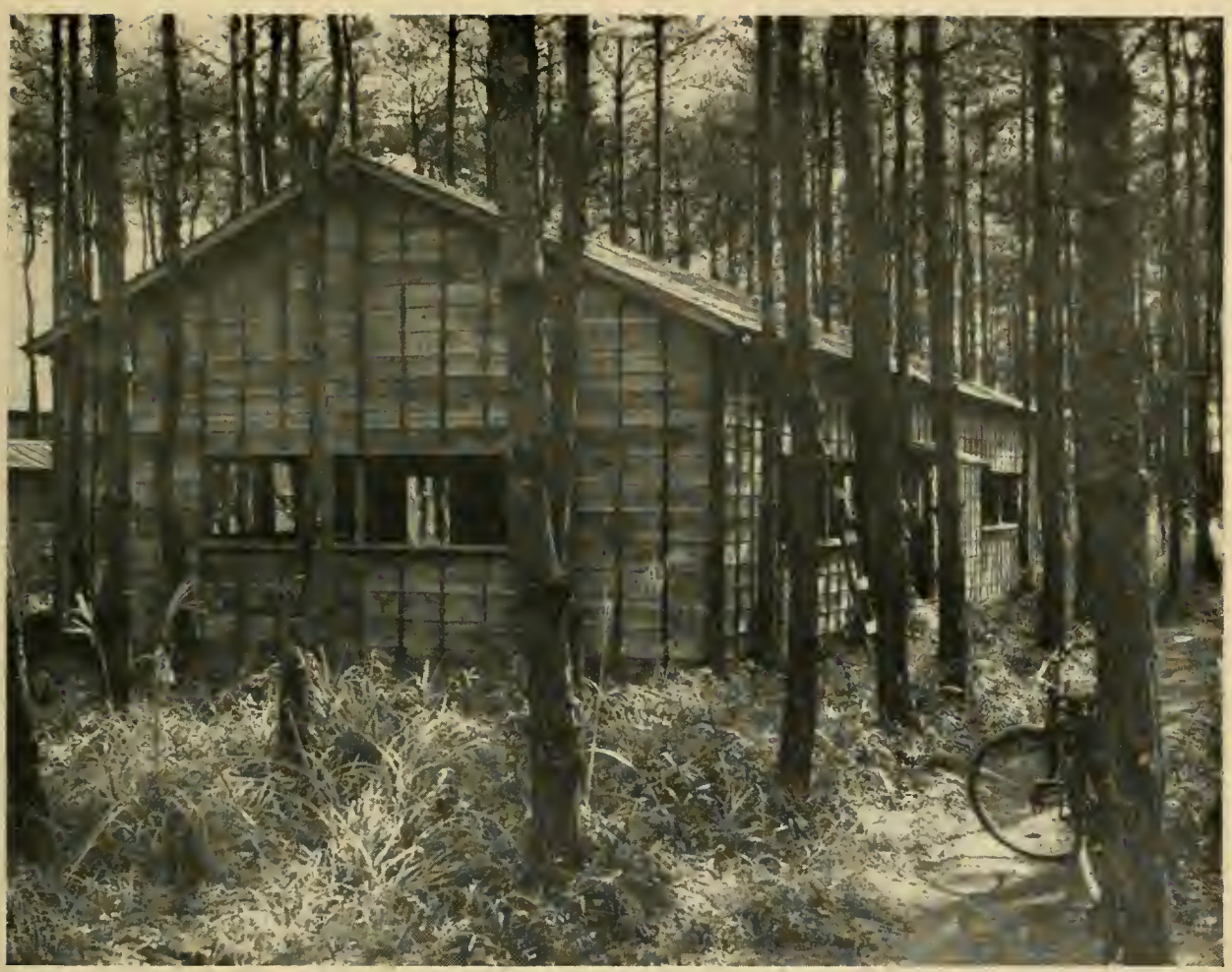


Photo 17—CHIBA PLANT.—Photograph of a dispersal site in the heavily wooded area outside of the city of Chiba. This particular site, the Miyazaka factory, was one of several dispersal divisions that were located in forests. Natural coverage from the trees and the technique of building the shops without destroying any of the forest increased the effectiveness of the location.

Photo 18—CHIBA PLANT.—Photograph of machinery installations in the forest plant at Miyazaka.

Dispersal of plant operations

The Chiba plant embarked upon a very extensive dispersal program in the fall of 1944 (Appendicies K–1, K–2, K–3, and K–4; photos 13, 14, 15, 16, 17, 18). The initial order to disperse activities of the airframe division was received in October 1944 and at that time, as primary dispersal sites, the airframe officials selected several above-ground locations in the city of Chiba. Since large numbers of school children had been mobilized for factory work, school buildings were vacant, and these locations were selected for initial dispersal sites.

Three school buildings were used: the Chiba Girls' High school, the Chiba Commercial School, and Tokyo Imperial University (engineering branch). Secondly, two abandoned buildings were converted to wing and fuselage assembly shops. In addition, the company built a number of tunnels and semi-underground buildings in the Oami district.

Officials of the engine divisions also selected schools for primary dispersal locations. Eight school buildings were made available and by June 1945, all locations were in operation. In addition, four small plants were built in the forest east and south of Chiba and a location, "Chichibu," similar to Oami was selected for tunnels and semiunderground shops.

Although installations were not complete at any of the locations chosen by the company, officials did not anticipate any difficulties in obtaining an adequate supply of labor or that bottlenecks would develop in power supply or transportation. Many laborers were already at work in the new plants and morale was high since at Oami, Chichibu, Miyazaki, Aradate and Someya, the largest dispersal sites, workers were relatively safe from bombing and working conditions were good.

Beginning in April 1945, both divisions of the plant attributed dispersal activities as the major contributing factor in production loss, but it was hoped that this loss could be completely overcome by December 1945.

Table No. 1 below lists the percentage of production loss by months.

TABLE 1.—*Dispersal loss*

	April 1945	May 1945	June 1945	July 1945	August 1945
Airframe division:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Machine work	20	80	60	45	30
Sheet-metal work		20	60	80	80
Engine division: Machine work	5	65	38	26	47

EVALUATION OF PRE-ATTACK INTELLIGENCE

Data compiled on the Chiba plant was excellent in most respects. Photo interpretation on this plant was particularly good. Intelligence had advance knowledge that the plant was planning to produce Zekes for combat. It was erroneously reported, however, that the Chiba was producing Kinsei engines.

VULNERABILITY

Had the one B–29 attack been highly accurate, this plant easily could have been destroyed as a producing unit early in June 1944. Machine-gun bullets from Navy strikes had no effect other than to punch holes in roofs of buildings and in some sheet metal parts. None of the three attacks seriously affected production.

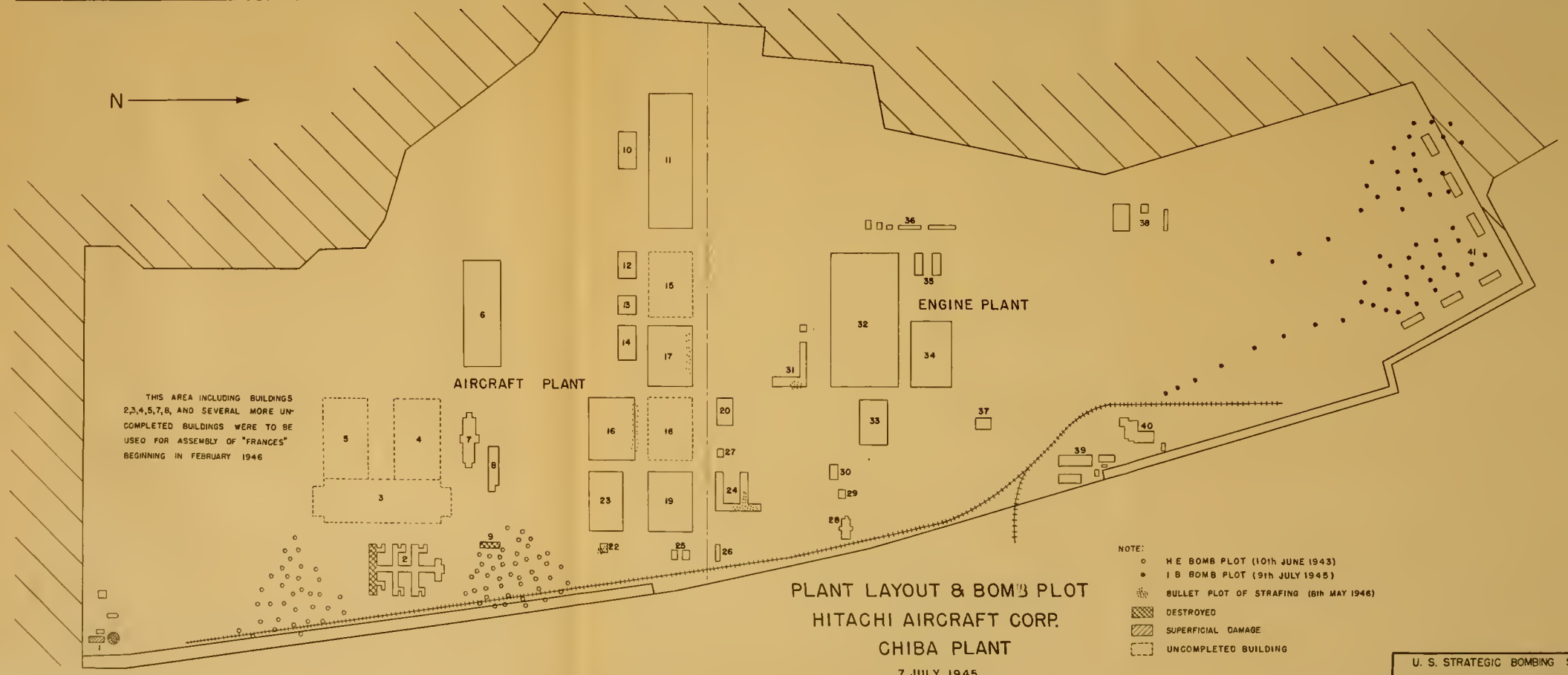
Workers' morale was low and subject to feelings of terror or hopelessness.

Four of the shops located in schools were destroyed by area attacks on the city of Chiba.

NO. OF BUILDING	FUNCTION	AREA (SQ. FT.)	CONSTRUCTION	DAMAGE	REMARKS
1	COAL GAS SHOP	8,911	STEEL FRAME TWO STORIED BLDG.	SUPERFICIAL (SOME OF EQUIPMENT BURNT)	
2	OFFICE FOR SPECIAL PLANT	43,038	WOODEN FRAME	27% AREA DESTROYED	SPECIAL PLANT
3	STORE ROOM	175,328	STEEL REIN. CONCRETE BLDS., IRON ROOF		CONSTRUCTION WAS STOPPED
4	MACHINARY SHOP	148,390	WOODEN FRAME, SHEET IRON ROOF		"
5	SHEET METAL MACH. SHOP	148,390	"		"
6	WOODEN WING SHOP	134,550	"		"
7	DINING ROOM	17,457	WOODEN FRAME		"
8	REPAIR SHOP	11,517	"		"
9	GUARD STATION	1,075	"	DESTROYED	"
10	PAINT SHOP	22,281	STEEL FRAME		AIRCRAFT PLANT
11	FINAL ASSEMBLY SHOP AND FUSELAGE, WING ASSEMBLY	205,666	STEEL FRAME, SHEET IRON ROOF		"
12	DINING ROOM	16,145	WOODEN FRAME		"
13	AIRCRAFT PLANT OFFICE	9,007	"		"
14	HEAT TREATMENT, SURFACE PROTECTING SHOP	19,375	"		"

NO. OF BUILDING	FUNCTION	AREA (SQ. FT.)	CONSTRUCTION	DAMAGE	REMARKS
15	SHEET METAL SHOP	84,725	WOODEN FRAME SHEET IRON ROOF		DISPERSED JUNE 1945
16	MACHINERY SHOP	84,723	"		AIRCRAFT PLANT
17	SHEET METAL	84,725	"		"
18	STORE ROOM	84,725	"		DISPERSED MAY 1945
19	SHEET METAL CUTTING & STORE ROOM	84,725	"		AIRCRAFT PLANT
20	DINING ROOM	16,145	WOODEN FRAME		"
22	BOILER SHOP	2,908	"		"
23	WOOD WORKING SHOP	71,042	WOODEN FRAME SHEET IRON ROOF		"
24	CENTRAL OFFICE	83,520	WOODEN FRAME TWO—STORY BLDG.		
25	STORAGE	5,360	WOODEN FRAME		
25	GARAGE	3,228	"		
27	TELEPHONE EXCHANGE	2,192	"		
28	HOSPITAL	12,815	WOODEN FRAME TWO—STORY BLDG		
29	FIRE BRIGADE STATION	2,330	WOODEN FRAME		

NO. OF BUILDING	FUNCTION	AREA (SQ. FT.)	CONSTRUCTION	DAMAGE	REMARKS
30	TRANSFORMER STATION	7,319	WOODEN FRAME		
31	ENGINE PLANT OFFICE	30,138	WOODEN FRAME TWO—STORY BLDG.		ENGINE PLANT
32	MACH & ASSEMBLY SHOP	310,003	STEEL FRAME SHEET IRON ROOF		"
33	STORE ROOM	45,056	WOODEN FRAME		"
34	HEAT TREATMENT, SURFACE PROTECTING SHOP	80,417	WOODEN FRAME SHEET IRON ROOF		"
35	STORE ROOM	9,041	WOODEN FRAME		"
36	TEMPORARY ENGINE TEST	17,222	"		"
37	BOILER SHOP	11,302	STEEL FRAME		"
38	ENGINE TEST SHOP	22,281	STEEL REINFORCED CONCRETE BLDG.		
39	KITCHEN	32,292	WOODEN FRAME		
40	WOOD WORKING MACH. SHOP	15,284	"		
41	STORE ROOMS	23,200	"		


N
AIRCRAFT PLANT
ENGINE PLANT
THIS AREA INCLUDING BUILDINGS 2,3,4,5,7,8, AND SEVERAL MORE UNCOMPLETED BUILDINGS WERE TO BE USED FOR ASSEMBLY OF "FRANCES" BEGINNING IN FEBRUARY 1946
NOTE:
H E BOMB PLOT (10th JUNE 1945)
I B BOMB PLOT (9th JULY 1945)
BULLET PLOT OF STRAFING (8th MAY 1946)
DESTROYED
SUPERFICIAL DAMAGE
UNCOMPLETED BUILDING

PLANT LAYOUT & BOMB PLOT
HITACHI AIRCRAFT CORP.
CHIBA PLANT

7 JULY 1945

TOTAL PLANT AREA 482 ACRES

U. S. STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT CORP.
CHIBA PLANT

APPENDIX A

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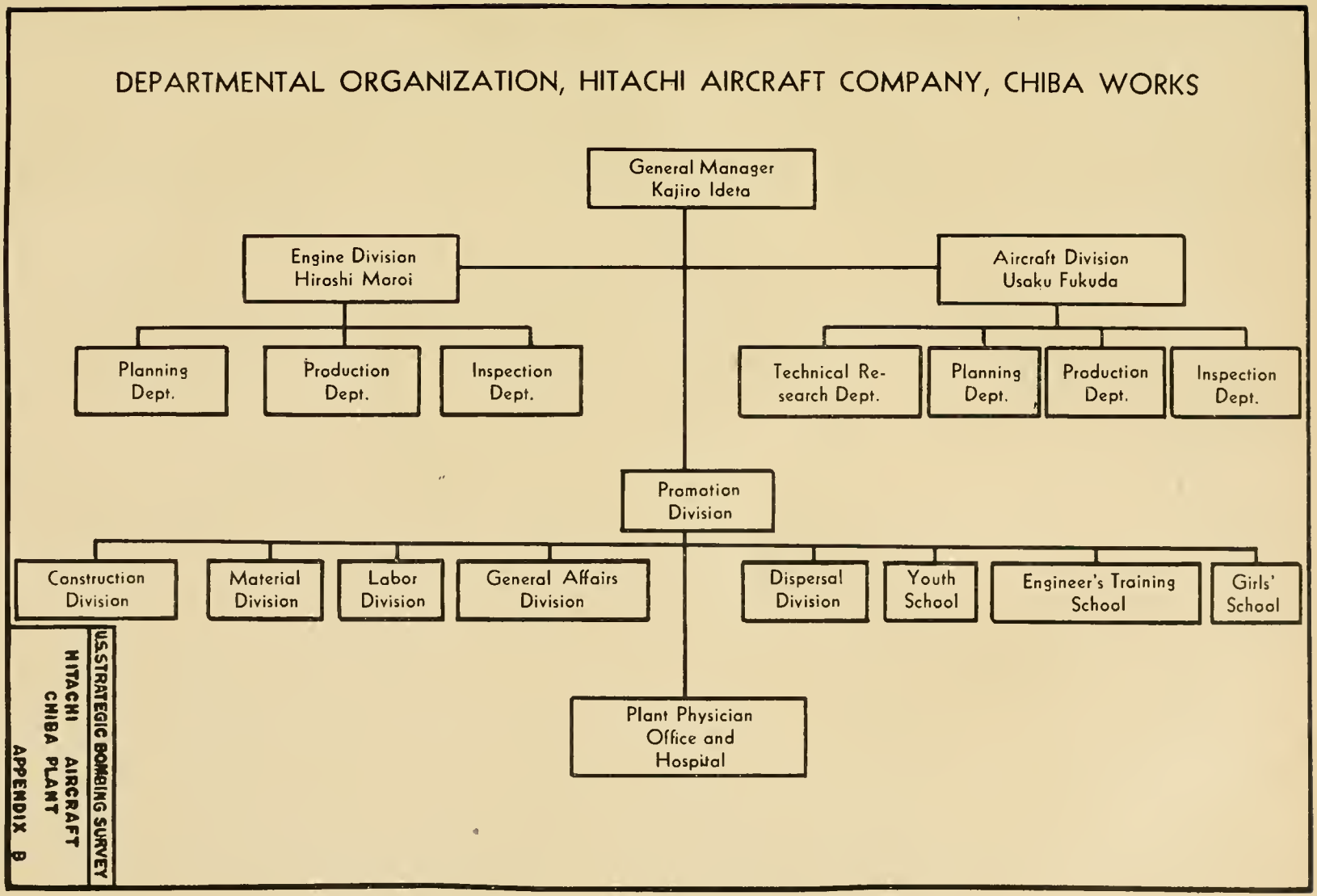
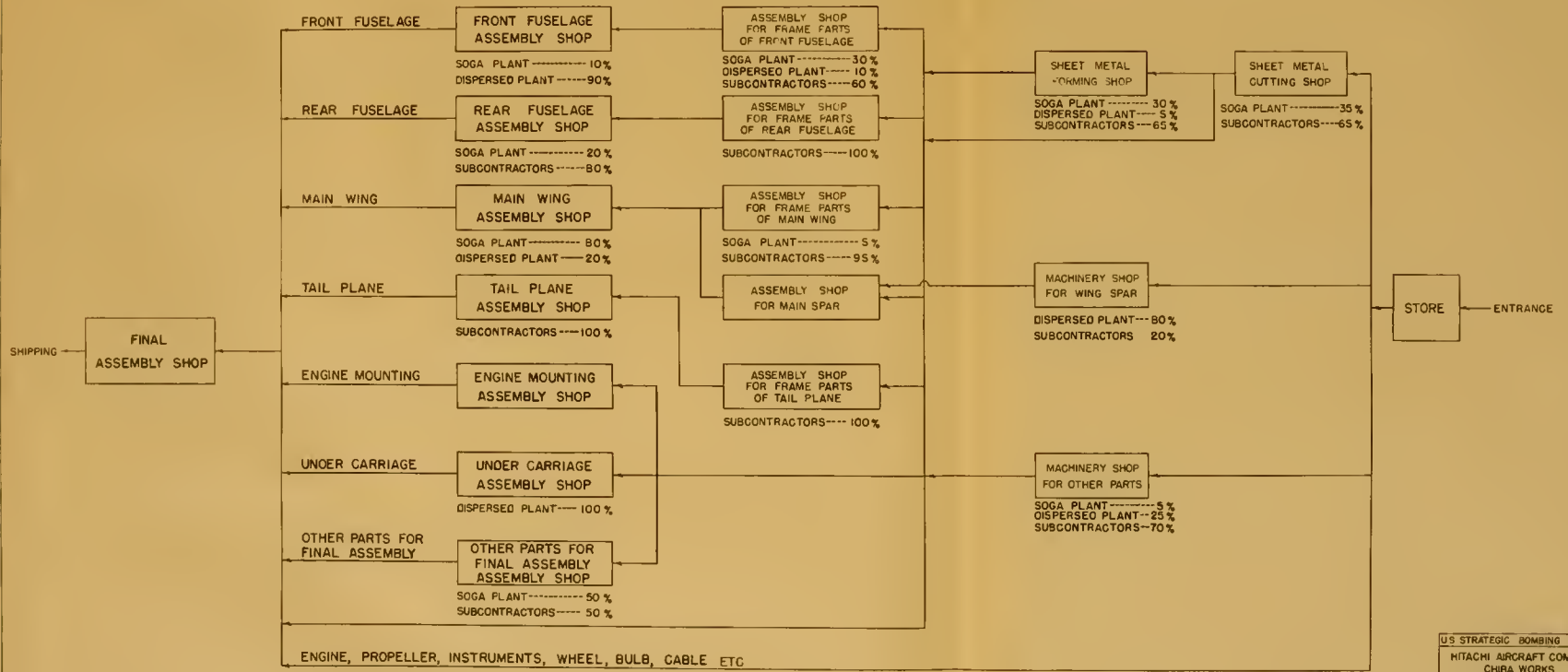

DEPARTMENTAL ORGANIZATION, HITACHI AIRCRAFT COMPANY, CHIBA WORKS
General Manager
Kajiro Ideta
Engine Division
Hiroshi Moroi
Aircraft Division
Usaku Fukuda
Planning Dept.
Production Dept.
Inspection Dept.
Technical Research Dept.
Planning Dept.
Production Dept.
Inspection Dept.
Promotion Division
Construction Division
Material Division
Labor Division
General Affairs Division
Dispersal Division
Youth School
Engineer's Training School
Girls' School
Plant Physician Office and Hospital
HITACHI AIRCRAFT
CHIBA PLANT
APPENDIX B
U.S. STRATEGIC BOMBING SURVEY

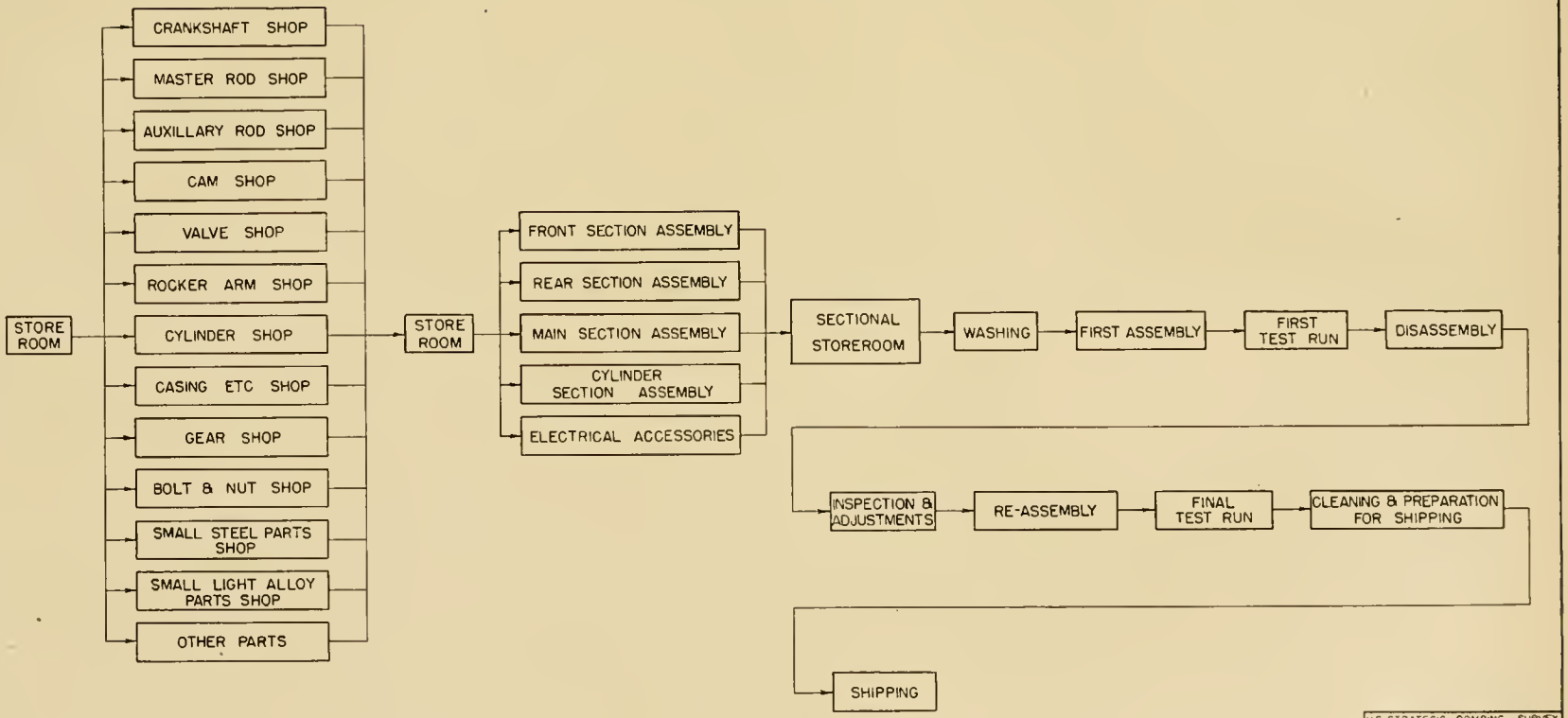
DIAGRAMMATIC PRODUCTION FLOW CHART



US STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT COMPANY
CHIBA WORKS
AIRFRAME DIVISION
APPENDIX-C
(ZEKE TRAINER)

DIAGRAMMATIC PRODUCTION FLOW CHART



APPENDIX E

Employment, airframe division, China plant, March 1943–July 1945

	Men	Women	Students	Total	Productive	Non-productive	Total	New hired	Total
1943									
March	772	5	0	777	236	541	777	450	1,227
April	2,231	137	0	2,368	292	2,076	2,368	1,193	3,561
May	2,177	134	0	2,311	319	1,992	2,311	508	2,819
June	2,633	153	0	2,786	318	2,468	2,786	76	2,862
July	2,671	153	0	2,824	315	2,509	2,824	164	2,988
August	2,804	182	0	2,986	321	2,665	2,986	175	3,161
September	2,977	192	0	3,169	2,286	883	3,169	483	3,652
October	3,431	200	0	3,631	2,629	1,002	3,631	61	3,692
November	3,414	251	0	3,665	2,721	944	3,665	373	4,038
December	3,760	274	0	4,034	2,990	1,044	4,034	102	4,136
1944									
January	3,838	296	0	4,134	3,149	985	4,134	245	4,379
February	3,867	486	0	4,353	3,288	1,065	4,353	377	4,730
March	4,147	533	0	4,680	3,455	1,225	4,680	2,596	7,276
April	5,699	1,490	85	7,274	4,585	2,689	7,274	286	7,560
May	5,541	1,469	325	7,335	4,281	3,054	7,335	661	7,996
June	5,398	1,855	348	7,601	5,587	2,014	7,601	157	7,758
July	4,940	1,451	809	7,200	4,719	2,481	7,200	15	7,215
August	4,732	1,437	931	7,100	4,772	2,328	7,100	5	7,105
September	4,748	1,435	931	7,114	4,676	2,438	7,114	249	7,363
October	4,368	1,465	1,160	6,993	4,798	2,195	6,993	491	7,484
November	4,990	1,304	1,574	7,868	5,274	2,594	7,868	442	8,310
December	5,412	1,296	1,613	8,321	5,420	2,901	8,321	152	8,473
1945									
January	5,325	1,356	1,779	8,460	5,571	2,889	8,460	361	8,821
February	5,337	1,551	1,879	8,767	5,912	2,855	8,767	102	8,869
March	5,110	1,485	2,200	8,795	6,110	2,685	8,795	30	8,825
April	4,931	1,455	2,360	8,746	5,848	2,898	8,746	61	8,807
May	4,790	1,438	2,397	8,625	5,751	2,874	8,625	22	8,647
June	4,628	1,438	2,544	8,610	5,740	2,870	8,610	25	8,635
July	4,359	1,403	2,544	8,306	5,616	2,690	8,306	5	8,311

Employment, engine division, Chiba plant, March 1943–July 1945

	Men	Women	Students	Total	Productive	Non-productive	Total	New hired	Total
1943									
March	661	7	0	668	275	393	668	111	779
April	959	30	0	989	285	704	989	222	1,211
May	935	31	0	966	288	678	966	128	1,094
June	1,051	38	0	1,089	292	797	1,089	7	1,096
July	1,049	39	0	1,088	292	796	1,088	185	1,273
August	1,212	58	0	1,270	292	978	1,270	216	1,486
September	1,384	93	0	1,477	988	489	1,477	18	1,495
October	1,375	103	0	1,478	1,105	373	1,478	117	1,595
November	1,421	121	0	1,542	1,132	410	1,542	156	1,698
December	1,566	125	0	1,691	1,245	446	1,691	206	1,897
1944									
January	1,758	141	0	1,899	1,322	577	1,899	630	2,529
February	2,312	246	0	2,558	1,824	734	2,558	158	2,716
March	2,418	278	0	2,696	1,985	711	2,696	1,341	4,037
April	3,205	746	58	4,009	2,403	1,606	4,009	163	4,172
May	3,122	732	217	4,071	2,472	1,599	4,071	204	4,275
June	2,969	950	233	4,152	2,622	1,530	4,152	444	4,596
July	2,721	452	541	3,714	2,688	1,026	3,714	12	3,726
August	2,993	684	623	4,300	2,376	1,924	4,300	4	4,304
September	3,006	684	623	4,313	2,843	1,470	4,313	302	4,615
October	3,179	686	775	4,640	2,804	1,836	4,640	10	4,650
November	3,082	510	1,051	4,643	2,857	1,786	4,643	101	4,744
December	3,129	677	1,077	4,883	2,998	1,885	4,883	244	5,127
1945									
January	3,335	581	1,186	5,102	3,397	1,705	5,102	440	5,542
February	3,628	700	1,186	5,514	3,552	1,962	5,514	84	5,598
March	3,536	562	1,467	5,565	3,376	2,189	5,515	21	5,586
April	3,186	447	1,574	5,207	3,332	1,875	5,207	293	5,500
May	3,416	468	1,598	5,482	3,519	1,963	5,482	35	5,517
June	3,177	442	1,697	5,316	3,290	2,026	5,316	43	5,359
July	2,930	531	1,697	5,158	3,329	1,829	5,158	7	5,165

APPENDIX F

Comparative amounts of raw materials ordered and received (tons), engine division, Chiba plant

Material	Total ordered	Received—1941												Ordered Apr.–Sept.	Received—1945					Total received (percent)
		Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.		Apr.	May	June	July	Aug.	
I. Special steel:																				
Plate	80.0	25.0	3.5	4.0	6.5	7.0	6.5	6.0	5.0	5.0	3.5	3.5	2.0	11.0	2.5	3.0	2.0	0.5	..	62.0
Pipe	52.0	..	2.0	4.0	4.0	3.0	3.0	2.5	2.0	1.5	1.5	1.0	.5	7.0	2.0	1.0	..	..	..	47.4
Bar	1,268.0	40.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	40.0	30.0	30.0	182.0	24.0	21.6	21.4	..	..	46.0
Forgings	3,181.8	3.8	28.3	40.5	10.2	97.0	35.2	103.5	64.5	159.5	72.3	141.4	85.4	..	50.1	23.6	45.8	19.5	..	30.8
II. Light metal alloy:																				
Plate	9.0	.2	.3	.3	.3	.5	.4	.3	.3	.2	.2	.1	.1	..	.3	.2	.2	..	..	43.3
Pipe	5.0	.1	.3	.4	.1	.1	..	.2	.2	.2	.15	.15	.1	..	.1	.1	.1	..	..	46.0
Bar	90.0	.5	.7	.8	1.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	.8	..	.4	.3	.3	..	..	15.3
Forgings	261.8	..	2.0	7.9	20.0	60.9	2.3	11.3	7.1	10.2	8.6	33.5	13.2	..	7.3	2.7	12.9	5.5	..	78.5
Castings	247.5	9.5	12.6	10.0	6.1	10.5	15.3	18.0	10.4	11.0	7.5	10.9	11.5	..	9.6	9.2	3.0	..	..	71.3
Airframe division, Chiba plant																				
I. Special steel:																				
Plate	502.6	2.0	3.6	5.5	8.8	15.5	29.8	28.4	29.1	29.5	27.2	25.8	20.5	27.8	20.3	20.0	18.8	1.8	..	54.0
Pipe	64.3	1.3	2.8	3.3	4.5	5.8	7.3	5.8	5.3	4.6	3.8	2.4	2.2	15.6	3.2	3.1	2.9	3.5	..	77.3
Bar	1,128.9	18.7	18.3	24.5	67.4	98.8	132.5	48.4	46.9	45.3	72.7	68.2	63.9	40.5	37.6	31.4	24.9	..	..	68.3
Wire	74.2	..	..	..	3.8	5.5	7.4	8.5	7.3	6.1	1.2	.8	.7	4.0	.5	.4	..	..	..	54.0
Forgings	88.4	..	..	..	..	..	..	1.6	2.8	4.0	12.8	20.3	27.9	23.2	10.3	4.8	2.4	6.8	..	83.9
Castings	..	..	..	..	..	..	..	..	..	..	..	..	..	20.2	3.6	2.4	1.2	1.5	1.5	50.5
Cable	13.9	..	..	.13	.9	1.5	1.8	2.0	1.0	.6	.1	..	..	2.6	..	..	..	.01	..	48.7
II. Light alloy:																				
Plate	560.2	16.3	22.4	28.6	47.6	45.0	41.9	20.3	24.5	18.6	22.2	21.0	21.0	124.3	50.6	42.5	35.1	..	..	66.9
Pipe	28.3	.9	1.8	2.6	1.9	1.8	1.6	.8	.1	.1	3.9	1.6	..	..	3.9	1.6	..	.6	..	82.0
Bar	170.4	.4	12.2	5.1	8.3	14.6	8.8	11.1	9.2	8.7	6.9	6.5	..	20.0	2.5	.8	..	5.0	..	52.6
Wire and rivet	38.3	1.5	4.2	1.5	.7	.2	..	.2	1.2	1.3	3.0	4.3	.5	9.9	3.7	2.5	2.0	5.1	6.5	79.6
Extrusions	89.0	.3	1.6	6.2	5.2	1.0	.9	2.0	1.1	.01	12.0	.3	.2	12.6	37.6	4.8	..	..	..	72.1
Forgings	21.6	..	.04	2.4	.4	4.5	1.0	2.1	1.5	.7	2.8	..	..	8.0	4.2	.7	.1	1.5	.05	74.2
Castings	31.8	.3	1.6	6.6	.4	.3	..	.3	..	..	.2	..	..	9.2	.3	.2	.2	..	..	25.36

APPENDIX G

Comparative amount of component parts ordered and received, Chiba plant

Part	Ordered Apr.–Mar.	Received—1944												Ordered Apr.–Sept.	Received—1945					Total (percent)
		Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.		Apr.	May	June	July	Aug.	
Engine (sakae 31)	297	3	5	6	18	28	38	25	25	26	28	31	31	257	16	15	12	..	..	55.4
Propeller	297	2	5	5	12	24	31	35	35	35	28	20	12	257	28	24	20	..	..	57.0
Wheel	297	6	6	10	12	14	16	21	35	35	35	35	30	257	38	42	38	36	3	74.4
Oleo-pneumatic shock absorber	297	6	6	10	12	16	19	23	35	35	32	25	10	257	28	26	22	18	2	58.7
Governor	297	2	4	6	18	30	35	26	25	20	25	28	20	257	20	16	14	12	2	54.7
Vacuum pump	297	2	3	7	8	10	14	36	33	30	28	25	20	257	18	18	14	32	6	54.9
High pressure pump	297	8	14	20	26	36	34	82	90	69	80	88	55	257	48	40	40	..	..	131.8
Generator	297	4	2	6	10	10	12	20	24	27	28	25	20	257	41	30	30	10	4	54.7
Electric tachometer	297	4	8	8	20	25	25	25	25	28	35	25	25	257	20	15	15	16	8	59.0
Boost pressure gage	297	6	8	8	12	20	20	30	35	40	33	25	25	257	30	33	30	14	..	66.6
Oil pressure gage	297	4	8	8	12	15	20	26	30	30	38	30	30	257	30	30	28	24	..	65.5
Oil thermometer	297	3	4	10	12	20	20	20	30	41	30	30	28	257	30	33	30	14	..	64.0
Exhaust gasoline thermometer	297	3	4	10	22	25	25	36	40	40	30	23	20	257	30	24	24	14	..	66.9
Exhaust thermometer	297	3	4	10	30	60	70	50	50	48	30	20	20	257	..	..	..	..	..	71.3
Compass	297	4	6	7	10	11	20	26	25	30	30	33	20	257	30	30	28	16	8	60.3
Altimeter	297	5	10	8	23	35	35	35	25	20	30	20	20	257	20	15	15	14	..	59.6
Turn indicator	297	2	4	6	18	24	30	35	34	40	30	30	33	257	30	38	30	20	4	73.6
Speed indicator	297	5	10	10	12	15	15	21	30	30	30	30	23	257	30	30	28	12	2	60.1
Carbureter	3,468	14	65	129	98	266	135	271	191	265	162	123	53	..	47	..	..	..	..	52.5
Magneto	7,870	235	31	335	198	480	843	611	512	358	406	360	393	..	585	366	443	..	..	78.2
Inertia starter	4,040	..	..	..	550	250	300	350	..	..	250	..	350	..	..	..	..	..	..	50.7
Fuel pump	6,860	220	106	302	130	198	231	144	260	190	175	195	285	..	66	147	20	110	..	40.5
Oil pump	6,500	37	115	120	152	160	143	247	218	408	..	294	312	..	45	133	412	..	..	43.0

APPENDIX H

Raw material and component part manufacturers, Chiba Plant

Nippon Seitetsu KK Yahoto-Kojo	Edomitsu-moti, Yahata	Special steel plate and bar.
Kawasaki Jukogyo KK	Wakihama-machi, Fukiai-Ku, Kobe	Special steel plate.
Daido Seiko KK	Hoshizaki-Cho Minomiku, Nagoya	Special steel plate bar and wire.
Toshiba Kokan KK	Minato-cho, Kawasaki (Kanagawa-Ken)	Special steel pipe.
Sumitomo Kinzoku-Kogyo KK	Amagasaki, (Hyogo-Ken)	Do.
Sumitomo Denki-Kogyo KK	Shinaya-cho, Kanohana-Ku, Osaka	Light alloyed materials, propeller, governor, and generator.
Nippon Kokan KK	Kawasaki, (Kanagawa-Ken)	Special steel pipe.
Mitsubishi Seiki KK	Oshima-cho, Joto-Ku, Tokyo	Special steel bar.
Mitsubishi Seiko KK Fukagawa-Kojo	Fukagawa-Ku, Tokyo	Special steel forged parts.
Nippon Tanko KK	Naka-gun, Kanagawa-Ken	Do.
KK Kobe Seikosha Akano-Kojo	Akano-machi, (Okayama-Ken)	Do.
KK Kobe Seikosho Chofu-Kojo	Chofu-machi, Shimonoseki (Yamaguchi-Ken)	Light alloyed bar, pipe, extruded, and forged parts.
KK Kobe Seikosho Nagoya-Kojo	Koonji-cho, Kita-Ku, Nagoya	Light alloyed bar and pipe.
Furukawa Denki-Kogyo KK	Nikko, Koitsu-gun, Tochigi-Ken	Light alloyed bar, pipe, extruded, and forged parts.
Tokyo Seiko, KK	Kawasaki (Kanagawa-Ken)	Cable.
Hitachi Kokuki KK Kawasaki-Kojo	Fujimi-cho Kawasaki (Kanagawa-Ken)	Light alloy castings.
Daini Kaigun Kokyusho	Kisayazi, (Chiba-Ken)	Aero engine (supplier).
Kyushu Hikoki KK	Naka-machi, Chikugushi-gun, Fukuoka	Wheel.
Dainippon Kika; Kogyo KK	Aoto-machi, Katsushika-Ku, Tokyo	Oleo-pneumatic shock absorber.
KK Tokyo Keiki Seisakusho	Higashikonagawa, Kamata-Ku, Tokyo	Vacuum pump and inertia starter.
KK Yokokawa Denki Seisakusho	Musashino Kitatama-gun, Tokyo	Magneto and electric tachometers.
Tanaka Koku-Keiki KK	Omori, Omori-Ku Tokyo	Tach indicator and press gage.
Tokyo Kiki-Kogyo KK	Nakashima, Kawasaki (Kanagawa-Ken)	Carburetor.

APPENDIX I

Planned capacity, and actual production statistics, April 1944–August 1945, Chiba plant, Hitachi Aircraft Co.

Month	Airframes			Engines													
	A6M5–K, Zeke trainer			Total engines			Tempu 21			Tempu 31			Tempu 11			Tsu 11	
	A	P	C	A	P	C	A	P	C	A	P	C	A	P	C	A	P
1944																	
April		2	2														
May	2	8	5														
June	7	13	10														
July	15	21	15	70	100	100	70	100									
August	19	36	25	80	80	125	80	80									
September	10	25	30	60	80	150	60	80									
October	19	30	35	65	100	175	65	100									
November	27	35	35	126	210	200	71	80		55	130						
December	25	35	40	81	260	200	21	100		60	160						
Total 1944	124	205	197	482	830	950	367	540		115	290						
1945																	
January	23	40	40	126	240	200	26	60		100	180						
February	8	40	45	111	260	200	55	60		56	200						
March	34	40	45	100	300	200	15	60		85	240						
April	21	50	30	81	180	160	16	40		50	100		15	40			
May	31	50	35	100	250	160	58	40			120		32	30		10	60
June	23	50	30	85	260	100	31	40			130		13	30		41	60
July	15	40	20	28	190	70	16	60			70					12	60
August		40			220	70		70			90						60
Total 1945	155	350	245	631	1,900	1,160	217	430		291	1,130		60	100		63	240
Trand total	279	555	442	1,113	2,730	2,110	584	970		406	1,420		60	100		63	240

APPENDIX J

Analysis of air attack damage

AIRFRAME DIVISION

Date	Weapon	Buildings	Area (square feet)	Machine tools
8 May 45	Cal. 50	None		
10 June 45	500-pound HE	Office building	3,000	
		Dispersed plant in Chiba damaged (Prefectural Girls' High School)	3,000	
7 July 45	IB	Gas plant damaged	1,000	
		Dispersed plant in Chiba area damaged (Prefectural Girls' High School)	2,100	15
		Dispersed plant in Chiba area damaged (Tokyo Imperial University)	5,000	50

ENGINE DIVISION

10 June 45	500-pound HE	Dispersed plant damaged (Chiba Girls' Normal School)	5,500	
7 July 45	IB	Dispersed plaot damaged (Municipal Girls' High School)	850	
		Dispersed plant damaged (Prefectural Technical School)	4,000	

APPENDIX K–1

Dispersal program, engine division, Chiba plant

No.	Dispersal location	Type of building	Area (square feet)	Products	Number of machine tools	Number of employees	Began production	Degree of progress (percent)	Map No.
A	Kemigawa primary school	Converted school	4,455	Small parts of light alleys	23	79	May 1945 (April 1945)	100	2
B	Nohuto, primary school	do	3,465	Rocker arms	27	89	May 1945 (April 1945)	100	1
C	Samukawa, primary school.	do	6,930	Testing	39	115	May 1945 (April 1945)	100	1
D	Anegasaki, primary school.	do	3,555	Small parts of light metal	18	55	May 1945 (April 1945)	100	2
E	Mobara, middle school	do	13,320	Small parts of steel	101	407	May 1945 (March 1945)	100	2
F	Chiba, technical school	do	4,995	Gears	30	119	July 1945 (June 1945)	100	2
G	Chiba, municipal, girls' high school.	do	10,620	Finishing	3	300	March 1945 (March 1945)	100	1
H	Normal school (boys)	do	8,910	Master rods and cams	52	240	May 1945 (April 1945)	100	1
I	Normal school (girls)	do	5,175	Link rods	38	151	April 1945 (March 1945)	100	1
J	Miyazaki	do	3,600	Finishing	20	120	March 1945 (March 1945)	100	1
K	Owada	do	21,330	Assembly and test running.	15	600	August 1945 (June 1945)	80	2
L	Someya	Forest plant	35,100	Cylinder head and small parts of steel.	158	450	June 1945 (June 1945)	100	1
M	Aradate	do	17,820	Casting	53	102	June 1945 (April 1945)	100	1
N	Miazaki	do	42,300	Cylinder barrels and heat treatment.	115	376	August 1945 (April 1945)	70	1
O	Nitona	do	26,730	Jigs and tools	145	450	August 1945 (April 1945)	30	1
P	Chichibu A	Underground (tunnel)	10,665	General machine work	596	2,500	(October 1945)		
Q	Chichibu B	(Buried)	53,370	Finishing and assembly	15	600	do		
R	Chichibu C	Hut	27,900	Heat treatment boring, casting and test running.	15	400	do		

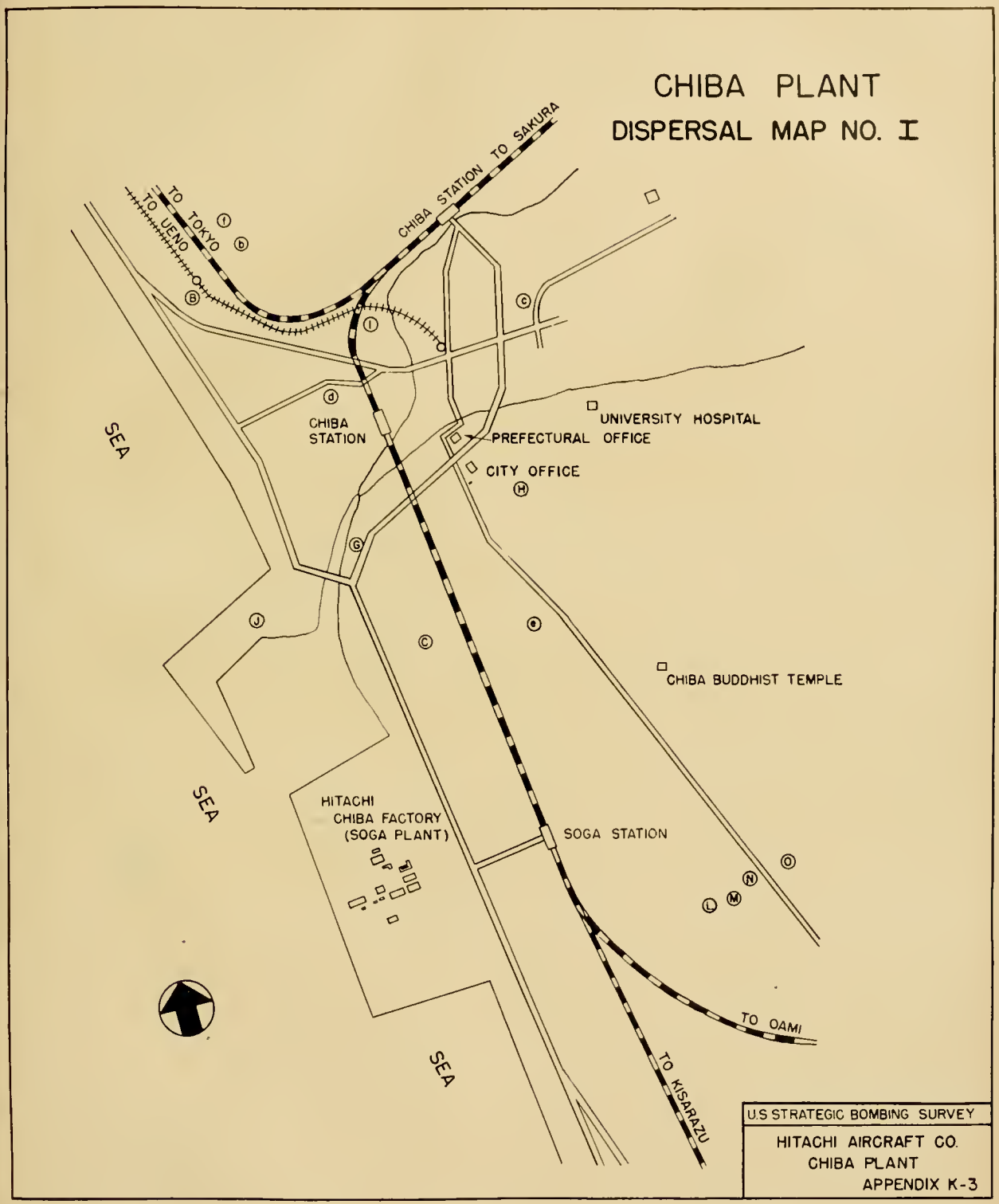
NOTE.—Month in parentheses when completion was planned.

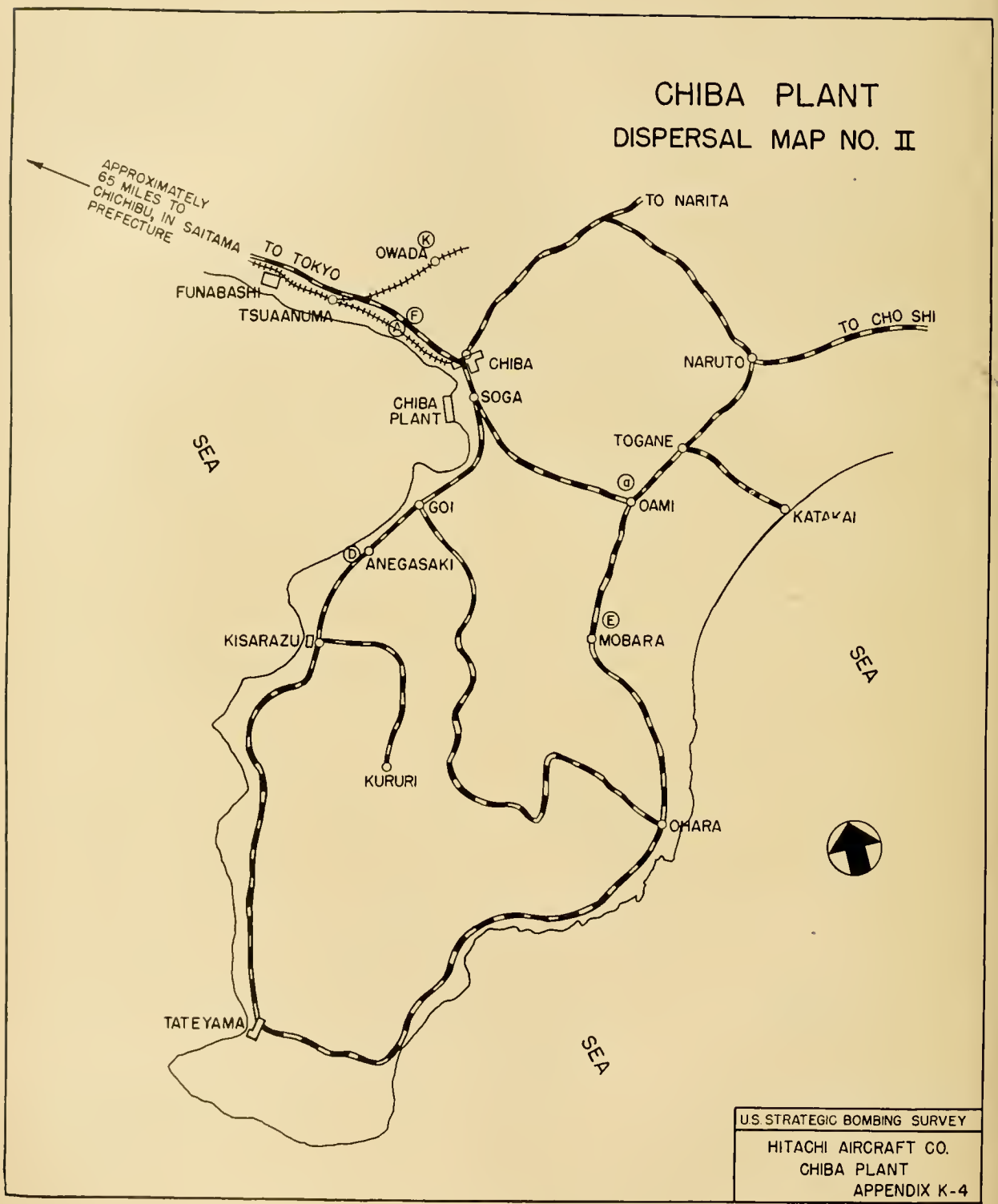
APPENDIX K–2

Dispersal program, airframe division, Chiba Plant

No.	Dispersal location	Building type	Area (sq. ft.)	Began production	Number of machine tools	Number of employees	Products	Degree of progress	Map No.
a	Oami	Semiunderground	133, 100 113, 800	May 1945	300	2, 000	Mechanical parts and sheet metal parts.	October 1945 (40 percent).	2
		Underground	120, 200 116, 820	June 1945	(277)	(518)			
b	Nishi-Chiba	Constructed building.	73, 510	February 1945 (March 1945)	36 (36)	800 (776)	Mechanical parts and fuselage.	August 1945 (60 percent).	1
c	Dairokuten	...do	5, 230	April 1945 (May 1945)	38 (33)	500 (184)	...do	September 1945 (60 percent).	1
d	Chiba, girls' high school	...do	20, 950	September 1944 (September 1944)	26 (6)	365 (0)	Wingtip instruments and board.	(100 percent)	1
e	Chiba, commercial school	...do	7, 370	(March 1945 (April 1945)	32 (32)	380 (274)	Fuselage and mechanical parts or fuselage.	September 1945 (70 percent).	1
f	The Department of Engineering of Tokyo, Imperial University.	...do	17, 460	February 1945 (March 1945)	83 (33)	70 (25)	Repair shop for machine tools.	100 percent	1

NOTES. 1. Values in parentheses show the actual condition at August 1945. 2. Number "d" and "f" were damaged by the air raid.


CHIBA PLANT
DISPERSAL MAP NO. I
CHIBA STATION TO SAKURA
TO TOKYO
TO UENO
CHIBA STATION
UNIVERSITY HOSPITAL
PREFECTURAL OFFICE
CITY OFFICE
CHIBA BUDDHIST TEMPLE
SEA
SEA
SEA
HITACHI
CHIBA FACTORY
(SOGA PLANT)
SOGA STATION
TO OAMI
TO KISARAZU
U.S STRATEGIC BOMBING SURVEY
HITACHI AIRCRAFT CO.
CHIBA PLANT
APPENDIX K-3


CHIBA PLANT
DISPERSAL MAP NO. II
APPROXIMATELY 65 MILES TO CHICHIBU, IN SAITAMA PREFECTURE
TO TOKYO
TO NARITA
TO CHO SHI
OWADA
K
FUNABASHI
TSUAANUMA
F
A
CHIBA
NARUTO
SOGA
CHIBA PLANT
TOGANE
SEA
a
GOI
OAMI
KATAKAI
D
ANEGASAKI
E
KISARAZU
MOBARA
SEA
KURURI
OHARA
TATEYAMA
SEA
U.S. STRATEGIC BOMBING SURVEY
HITACHI AIRCRAFT CO.
CHIBA PLANT
APPENDIX K-4

TACHIKAWA PLANT REPORT No. VII–2

(Engines)

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THE PLANT AND ITS FUNCTION IN THE AIRCRAFT INDUSTRY

Introduction

The Tachikawa plant (Tachikawa Seisakusho) of the Hitachi Aircraft Corporation (Hitachi Kokuki K K) was located at Yamato, about 19 miles west of the Imperial Palace in Tokyo, and a few miles north of the city of Tachikawa. The plant area embraced approximately 10,460,000 square feet, and the 67 buildings contained a total of approximately 1,111,900 square feet of floor area. Built in 1938, the original plant area was expanded to approximately 4 times its original size, the floor area increasing from the original 429,000 square feet through successive additions of shops and offices (Appendix A).

When the Hitachi Aircraft Corporation was formed in 1939, the Tachikawa plant was one of those taken over from the Hitachi Manufacturing Co. (Hitachi Seisakusho). The Tachikawa plant had been engaged in making small radial engines for Army aircraft, and in the new company it continued in the same capacity. In 1942, Tachikawa undertook production of larger engines of the 1,000-horsepower class, and in 1945 produced a few of the 2,500-horsepower class (photos 1 and 2).

The Tachikawa plant was the biggest engine manufacturing plant of the company, producing approximately 250 engines each month in 1944, representing about 50 percent of the Hitachi output.

The plant was confined to production for the Japanese Army and there were members of the Army present at all times in the capacity of material and acceptance inspectors. No other government officials were connected with the plant in any way, and the plant was never subsidized or supported, in any of its activities, by government financial aid.

Although concerned only with the production of radial aircraft engines, the Tachikawa plant since 1939 had assembled some seven different types, ranging from 300 horsepower to 2,500 horsepower. At the end of the war it was producing three engines in quantity (Ha–13KO, 450 horsepower; Ha–31–15, 880 horsepower; and Ha–33–62, 1,250 horsepower) and conducting hurried experiments on the new Army engine designated Ha–5 (Fig. 1).

TACHIKAWA PRODUCTS PERIOD OF PRODUCTION

ENGINE DESIGNATION	HP	1939	1940	1941	1942	1943	1944	1945
HA-12 (HA21 MOD11)	150	MAY					JUNE	
HA-42 (HA22 MOD11)	286					JULY	NOV	
HA-13 (HA23 MOD13)	350	MAY				JULY		
HA-13 KO (HA23,MOD22,23,24)	450	MAY						
HA-26 (HA31 MOD15)	880			APRIL				
HA-112 (HA33 MOD62)	1250						JUNE	
HA-51	2500						APRIL	

FIRST DESIGNATION IS OLD ARMY DESIGNATION NEW ARMY—NAVY DESIGNATION IS GIVEN IN PARENTHESES

RECORDS OF PRODUCTION BEFORE APRIL 1943 WERE DESTROYED IN AIR RAIDS

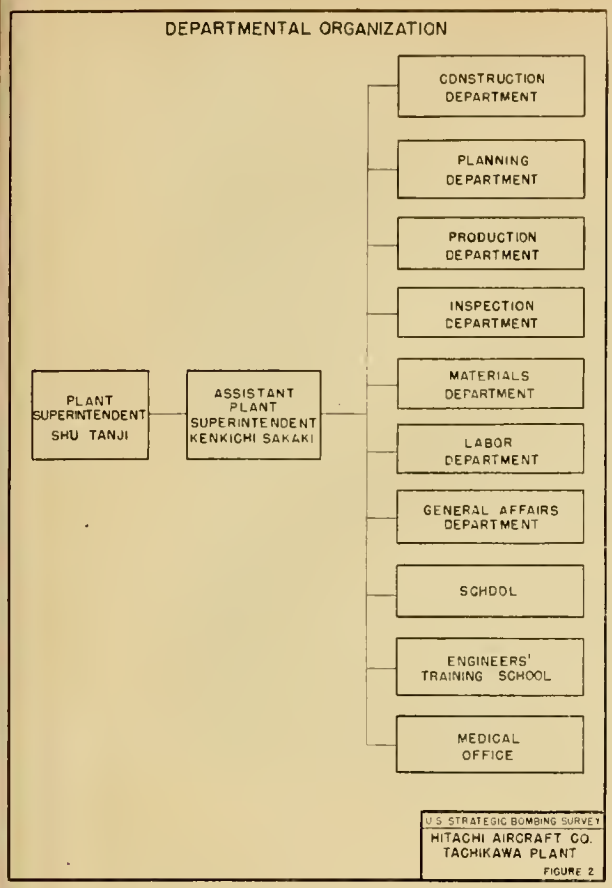
U S STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT COMPANY TACHIKAWA PLANT FIGURE 1

Organization and operation

The plant was under the general management of Shu Tanji, assisted by Kenkichi Sakaki, who was also the nominal head of the plant's most important department, the Planning Department, which was responsible for the paper work in connection with company production. There were 10 major plant departments, and each department in turn was divided into sections relating to a particular function (Fig. 2).

At the Tachikawa plant, production line technique was used in the assembly of engines. The individual engines were staged along a processing line and the various components were assembled by personnel particularly trained in each respective phase. The accessories, magnetos, carburetors, starters, etc., were then installed and the engines sent to one of the test cells for the green run (Appendix B).



Employment

In September 1944 employment at the Tachikawa plant reached its highest peak. During that month 13,896 workers were employed, of which 6,400 were classed as "productive labor" (Appendix C).

Until November 1943, this plant operated a single 11-hour shift from 0700 to 2000. Army production quotas were heavy from November 1943 onward, however, particularly for the Ha–13 KO and Ha–31–15 engines, so in an attempt to fill the assigned quota, Hitachi ordered Tachikawa to begin work on a two-shift basis at that time. Two 12-hour shifts were used, but the first, or day, shift included about 80 percent of the employees, and during the night shift only a few of the smaller shops, machinery and heat treatment, were operated. When an abundance of student laborers became available in September 1944, Tachikawa changed to three shifts of 8 hours each, and were using that arrangement when the war ended. Foreign labor was not used at any time, and the small percentage of soldier labor was discharged soldiers who were included under the male category.

During the second quarter of 1944 the plant worked 5,574,000 man-hours, the highest quarterly figure in the plant's history. Of this amount approximately 40 percent were classed as productive (Fig. 3).

Materials and components

Contracts and formal requests for engine materials or component parts were made by the Hitachi Corporation for the Tachikawa plant. There were 15 suppliers of materials including aluminum and magnesium castings, steel forgings, bars, pipes, and light alloys (Appendix D). The Tachikawa plant received all fuel pumps used in the production of Ha–13KO engines from a subsidiary plant, the Nitoka Precision Instrument Co., in addition to raw material supplies.

Through August of 1944 percentages of receipts ran high (Appendix E), and in most categories officials explained that up to that time production was not influenced greatly by any lack of materials or parts. However, from March 1945 until the end of the war, alerts, attacks, and actual physical damage to plants did cause serious interruptions in supply. Some of the most critical items were special steel forgings from the Kobe Steel Co. and Daido Steel Co.; copper alloy sheets from the Riken Light Alloys Co.; and copper wire, carburetors, and magnetos from the Tokyo Instrument Co.

Large and small forgings were made by outside sources, as were castings (the majority by Hitachi's foundry at Kawasaki). Tachikawa machined and finished these parts and completed the final engine assembly.

Substitute materials used by Tachikawa are included in the USSBS Aircraft Division Corporation, Report No. VII.

Production statistics

All production records previous to April 1943 were destroyed in air raids. The Tachikawa plant produced approximately 6 percent of the total Japanese engines in 1943 and about 5 percent in 1944. Its principle product, in point of volume of production, was the Ha–13KO engine, of which a total of 3,390 was completed between April 1943 and July 1945 (Appendix F and Fig. 4). With the shift in trend to higher horsepower engines (Ha–33 and Ha–51) in 1945, however, production dropped to only slightly more than 3 percent of Japan's total.

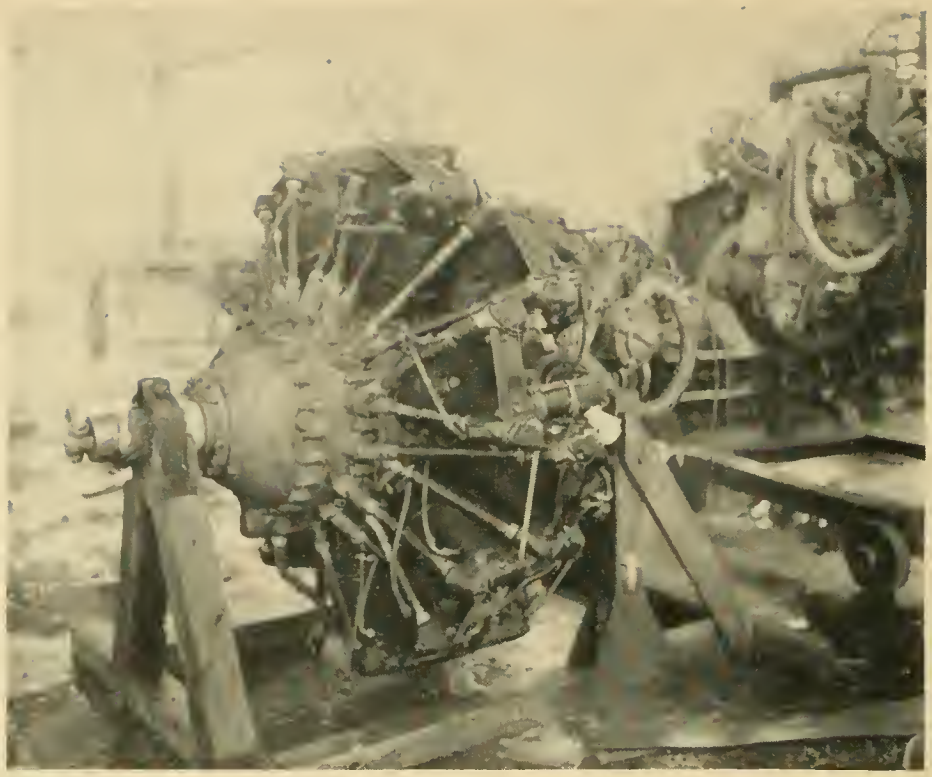


Photo No. 1.—Ha-112 (Ha-33 model 62) engine, side view, in assembly shop, building 1, Tachikawa plant

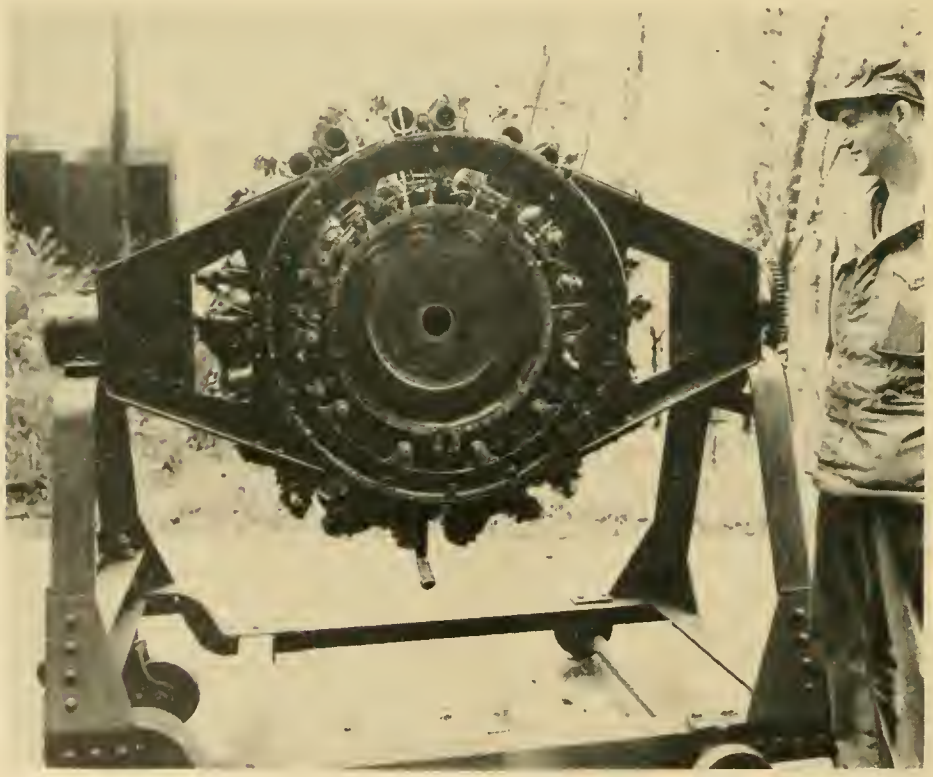
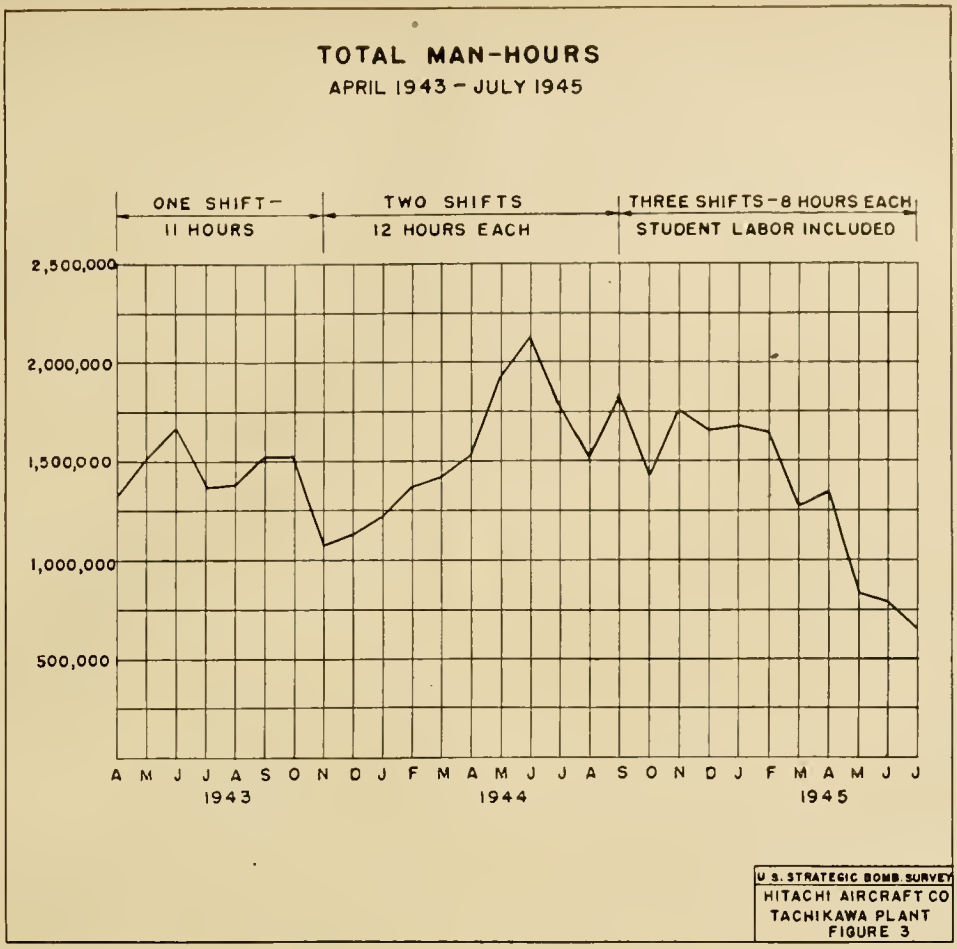


Photo No. 2.—Ha-51 engine, rear view, showing engine without blower section.


TOTAL MAN-HOURS
APRIL 1943 - JULY 1945
ONE SHIFT - 11 HOURS
TWO SHIFTS 12 HOURS EACH
THREE SHIFTS - 8 HOURS EACH STUDENT LABOR INCLUDED
2,500,000
2,000,000
1,500,000
1,000,000
500,000
A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1943
1944
1945
U. S. STRATEGIC BOMB. SURVEY
HITACHI AIRCRAFT CO
TACHIKAWA PLANT
FIGURE 3

In 1944, the biggest production year of the plant, 2,250 engines of all types were produced. This represented 79 percent of government order and 57 percent of capacity.

Production for the first 8 months of 1945 was considerably less than either government orders or capacity. Only 406 engines, or 24 percent of government orders and 53 percent of capacity, were delivered. Production and engineering difficulties encountered in manufacturing the Ha–33 contributed greatly in limiting production during the first 3 quarters of 1945. Government orders for this engine for that period were only 7 percent fulfilled, thus causing a great drop in over-all percentage figures (Figs. 4, 5, 6, 7, 8, 9, 10).

In addition, diversion of trained engineers, foremen, and mechanics, together with shops and test cells, to the development of the new Ha–51 engine was instrumental in causing a drop in production. Five of these engines had been ordered by the government, and three had been built at great cost in time and materials.

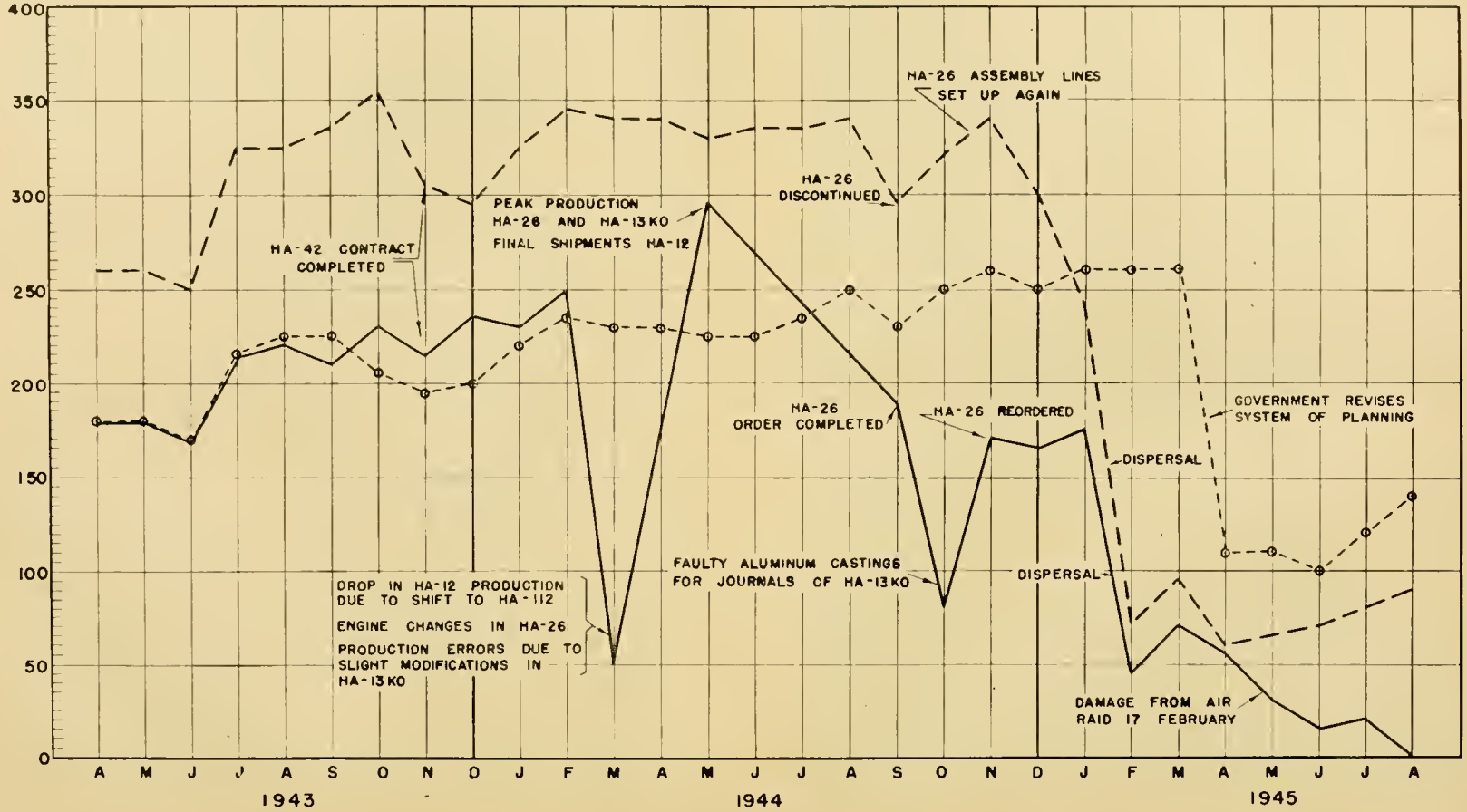
ATTACK DATA

Intelligence data:	
Date and hour of attack	24 April 1945.
Duration	9 minutes.
Attacking unit	Twentieth Air Force B–29s.
Altitude	12,250 feet.
Number of aircraft over target	101.
HE-number, weight, and type	1,894 (473.5T) 500-pound GP.
HE-fuzing	0.01 delay nose, inst. tail.
IB-number, weight, and type	
IB-fuzing	
On-the-ground findings:	
HE-number in plant area	[1] 450.
HE-number of building hits.	[1] 100.
HE-number of UXB	50.
IB-number in plant area	
IB-number of building hits	
IB-number of UXB	

[1] Approximate.

OVERALL PLANNED, CAPACITY, AND ACTUAL PRODUCTION

APRIL 1943 - AUGUST 1945



LEGEND

——— ACTUAL PRODUCTION

— — — PRODUCTION CAPACITY

– –⊙– – GOVERNMENT PLANS

U.S STRATEGIC BOMB. SURVEY

HITACHI AIRCRAFT CO.
TACHIKAWA PLANT
FIGURE 4

PLANNED, ACTUAL, & CAPACITY PRODUCTION APRIL 1943–MARCH 1945

FIGURE 5

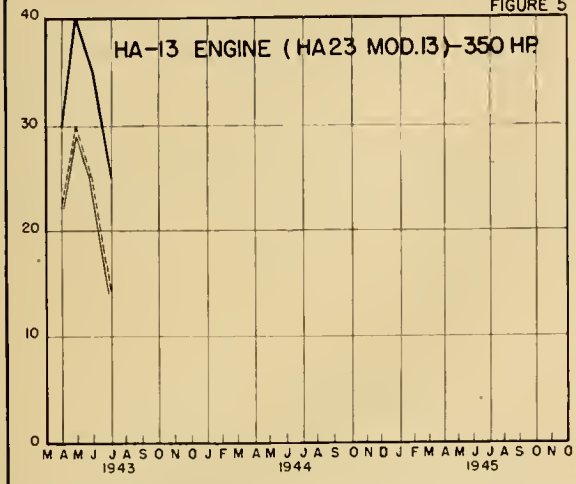


FIGURE 6

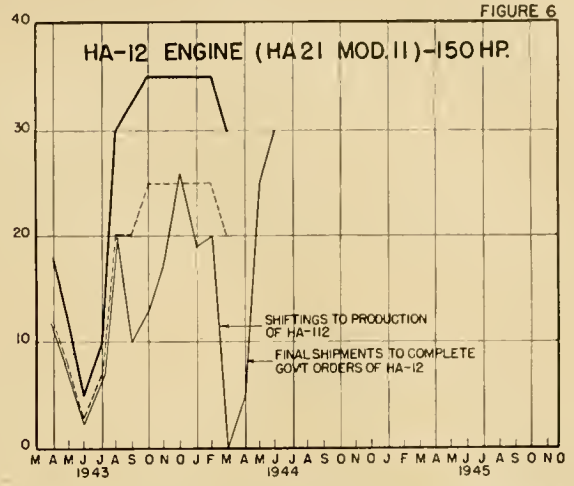

HA-12 ENGINE (HA21 MOD.11)-150 HP.
40
30
20
10
0
SHIFTINGS TO PRODUCTION OF HA-112
FINAL SHIPMENTS TO COMPLETE GOV'T ORDERS OF HA-12
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N O
1943
1944
1945

FIGURE 7

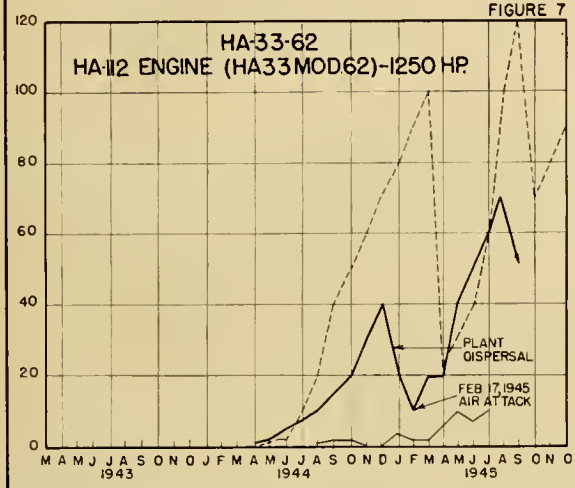


FIGURE 8

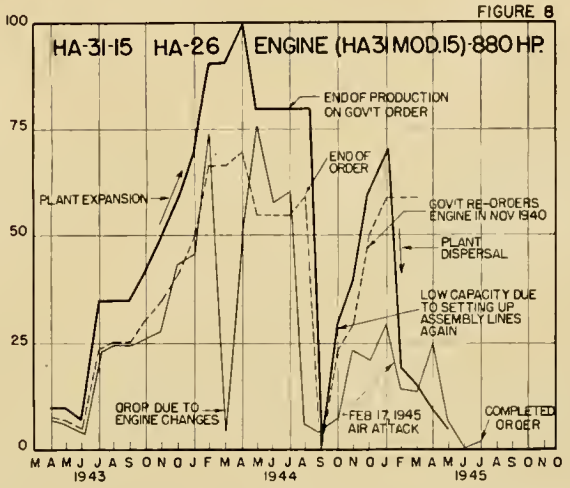

HA-31-15 HA-26 ENGINE (HA31 MOD.15)-880 HP.
100
75
50
25
0
END OF PRODUCTION ON GOV'T ORDER
END OF ORDER
PLANT EXPANSION
GOV'T RE-ORDERS ENGINE IN NOV 1940
PLANT DISPERSAL
LOW CAPACITY DUE TO SETTING UP ASSEMBLY LINES AGAIN
DROP DUE TO ENGINE CHANGES
FEB 17, 1945 AIR ATTACK
COMPLETED ORDER
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N O
1943
1944
1945

FIGURE 9

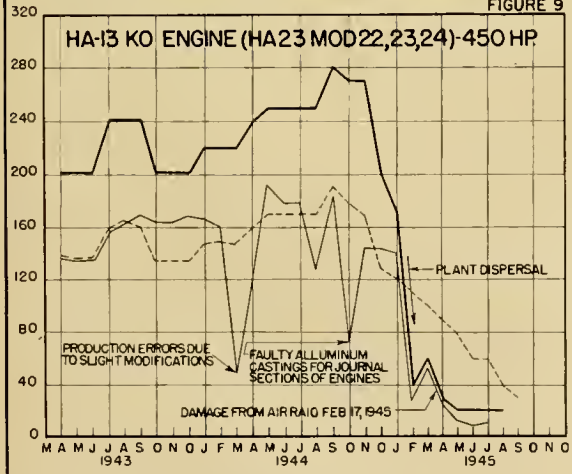
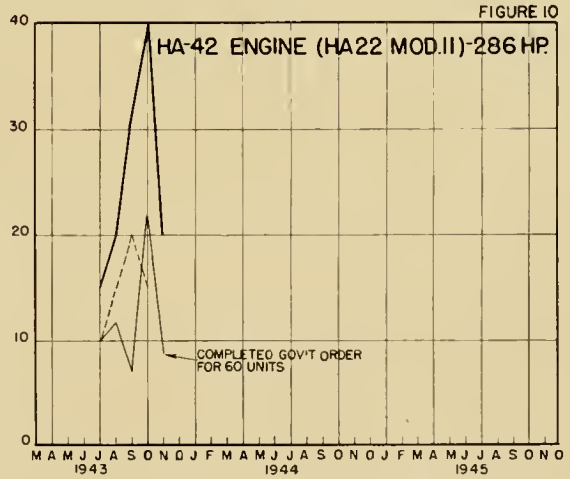

HA-13 KO ENGINE (HA23 MOD 22,23,24)-450 HP.
320
280
240
200
160
120
80
40
0
PLANT DISPERSAL
PRODUCTION ERRORS DUE TO SLIGHT MODIFICATIONS
FAULTY ALLUMINUM CASTINGS FOR JOURNAL SECTIONS OF ENGINES
DAMAGE FROM AIR RAID FEB 17, 1945
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N O
1943
1944
1945

FIGURE 10


HA-42 ENGINE (HA22 MOD.11)-286 HP.
40
30
20
10
0
COMPLETED GOV'T ORDER FOR 60 UNITS
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N O
1943
1944
1945

MAXIMUM CAPACITY PRODUCTION
GOVERNMENT PLANNED PRODUCTION
ACTUAL PRODUCTION

U.S. STRATEGIC BOMBING SURVEY

TACHIKAWA PLANT
HITACHI AIRCRAFT COMPANY

FIGURES 5,6,7,8,9,10

DISPERSAL PROGRAM, TACHIKAWA PLANT, HITACHI AIRCRAFT CO.

INDEX NUMBER ON DISPERSAL MAP	NAME	BLDG. AREA (SQ. FT)	DATE OF DISPERSAL	TOTAL MACHINE TOOLS	TOTAL WORKERS	PRODUCTS	COMPLETED DISPERSAL	PLANNED CAPACITY
1	Yamato Bldg Nº 1	6,800	25 Feb 1945	34		Crankcases	April 1945	(Combined estimated production at 200 engines per month; 100 HA 13 KO plus 100 HA 112)
2	" " Nº 2	6,800	20 Mar. 1945	82		Bolts & nuts	April 1945	
3	" " Nº 3	6,800	20 Mar 1945	35	470	Cam case, reduction case, & front case	May 1945	
4	" " Nº 4	6,800	20 Mar 1945	43		Rear case	May 1945	
5	" " Nº 5	6,800	23 Mar 1945	40		Impeller shaft & impeller drive shaft	May 1945	
6	" " Nº 6	6,800	31 Mar 1945	35	350	Post-assembly adjustments	May 1945	
7	" " Nº 7	6,800	1 Apr 1945	15			May 1945	
8	Rinkan Bldg. Nº 1	6,800	Jan. 1945	47		Sub-assembly HA-13KO	Feb. 1945	
9	" " Nº 2	6,800	Dec. 1944	26		Sub-assembly HA-26 & HA-112	Feb. 1945	
10	" " Nº 3	6,800	Dec. 1944	28	510	Sub-assembly	Feb. 1945	
11	" " Nº 4	6,800	Feb 1944	61		Gears	Mar 1945	
12	" " Nº 5	6,800	Mar. 1944	38		Reduction gears & cam	April 1945	
13	" " Nº 6	6,800	Mar. 1944	47		Master rods	April 1945	
14	Tani Bldg. Nº 1	6,800	April 1944	45		Cylinder barrel	May 1945	
15	" " Nº 2	6,800	7 Feb. 1945	21		Small aluminum alloys	May 1945	
16	2nd Boys Commercial School Bldg Nº 1	6,800	Jan. 1945	3	650	Sub-assemblies	Feb. 1946	
17	2nd Boys Commercial School Bldg Nº 2	6,800	9 April 1945	19		Cylinder heads	May 1945	
18	4th Girls High School	6,100	Jan. 1945	21		Small aluminum alloys	Feb 1946	
19	Tsuda Girls College	6,420	Nov 1945	27	200	Pistons	Dec. 1945	
20	Jiyu Gakuen College	3,960	Jan. 1945	17		Tappets & tappet guides	Mar 1945	
21	Seimei Primary School		May 1945			Assembly, finishing washing & preserving	July 1945	
22	2nd Hanno Primary School		May 1945	10 machines plus assembly jigs for HA 13 KO & HA 112	520	Overhaul & post assembly adjustments	Aug 1945	
23	Haraichiba Primary School	56,500	June 1945			Sub-assemblies	Aug. 1945	
24	Akasawa Primary School		June 1945			Tool room	Aug. 1945	
25	Minami Takakama Primary School		June 1945			Warehouse	Aug. 1945	
26	Yokota Tunnel Factory Nº 4	10,165	June 1945	33	310	Rocker arm boxes	Aug. 1945	
27	Yokota Tunnel Factory Nº 5	10,165	June 1945	58		Connecting rods	Aug. 1945	
28	Honjo Bldg.	7,062	July 1945	19	120	Cylinder heads	Aug. 1945	
29	Yashima Underground Factory	248,500	Feb. 1945	1,280	8700	Complete engines	June 1946	

U.S STRATEGIC BOMB. SURVEY

HITACHI AIRCRAFT COMPANY
TACHIKAWA PLANT
FIGURE 11

EFFECTS OF BOMBING

The air attacks

Located in an area that abounded with small aircraft plants, Army arsenals, and small manufacturing plants, the Tachikawa plant was attacked only twice. The plant was severely damaged by the United States Navy carrier plane strikes of 17 February 1945 directed against Nakajima's Musashi and Tachikawa Aircraft main plants; the 24 April attack by the Twentieth Air Force produced very heavy damage to the main plant (photo 3).

The plant was approximately 50-percent destroyed as a result of the air attacks. The assembly shop, heat-treatment shop, and the jig and tool-making shops were rendered inoperative, thus completely curtailing any further production unless exhaustive repairs were made.

The number of man-hours required to repair the damage sustained in the 17 February attack was estimated to be about 300,000. The 24 April attack then wrecked the plant completely. No repairs were undertaken thereafter since it was thought the time required for repair could better be employed in construction of the various underground dispersal sites.

A list of the number of man-hours lost because of air-raid damage is shown in Table 1.

TABLE 1.—*Man-hours lost due to air-raid damage*

Building No.		Man-hours lost	
		17 Feb. 1945	24 Apr. 1945
1	Assembly section	100,000	150,000
1	Machine shop section	300,000	200,000
5	Machine shop	150,000	230,000
4	Heat-treatment shop	50,000	50,000
3	Experimental shop	80,000	100,000
12	Dispersed machine shop		50,000

Photo No. 3.—Assembly shop (building 1) Tachikawa plant.

Countermeasures

As a countermeasure in combating the menace of continued bombings, the plant had organized two district air-raid defense details. One, the "Special Air Defense Corps" was composed of workers from every department of the plant divided into four sections known as (1) the Guard Section (2) the Fire Brigade (3) the Repair Section and (4) the Gas and Relief Section, each performing functions as indicated by their titles. In addition, a "Unit Air Defense Corps" was organized in each office and shop whose function was similar to the Special Air Defense Corps, but whose responsibility was limited to the immediate area of their respective shops.

In addition to these defense parties, the plant provided air-raid shelters in the plant compound for personnel of the plant. After the initial air attack, the safety of these shelters, which were poorly made of wood covered with earth, was rejected by most workers who preferred the fields and forests adjacent to the plant.

Interruptions due to alerts

Incomplete records at the plant did not reveal the number of man-hours lost because of alerts, but the plant manager estimated that from February until June, approximately 20 percent of the employees' time was lost because of this reason. Absenteeism because of alerts ran extremely high, about 80 percent from 1 July until August 1945.

Dispersal

Receiving orders in the fall of 1944 from the Hitachi main office to disperse the activities of the various shops and assembly lines, the Tachikawa plant began to move some sections of the plant as early as December 1944. At the end of the conflict all sites for dispersal except the Yashima underground factory, which was approximately 20 percent completed, were in operation (Fig. 11). A few buildings at the Tachikawa plant were to be retained and the other sites selected were in the general vicinity of the plant. Officials estimated full recovery from dispersal would be accomplished in December 1945 (Photos 4 and 5).

The dispersals were located in the Tokyo area and adjoining prefectures (Fig. 12).

INTELLIGENCE CHECK

Data was not available on intelligence estimates of the lighter engines produced by Tachikawa since War Department Military Intelligence Service (G–2) did not estimate monthly production rates of trainer engines. Estimates based on incomplete information of production of the Ha 31 15 engines when checked against actual production were found to be high in most cases.

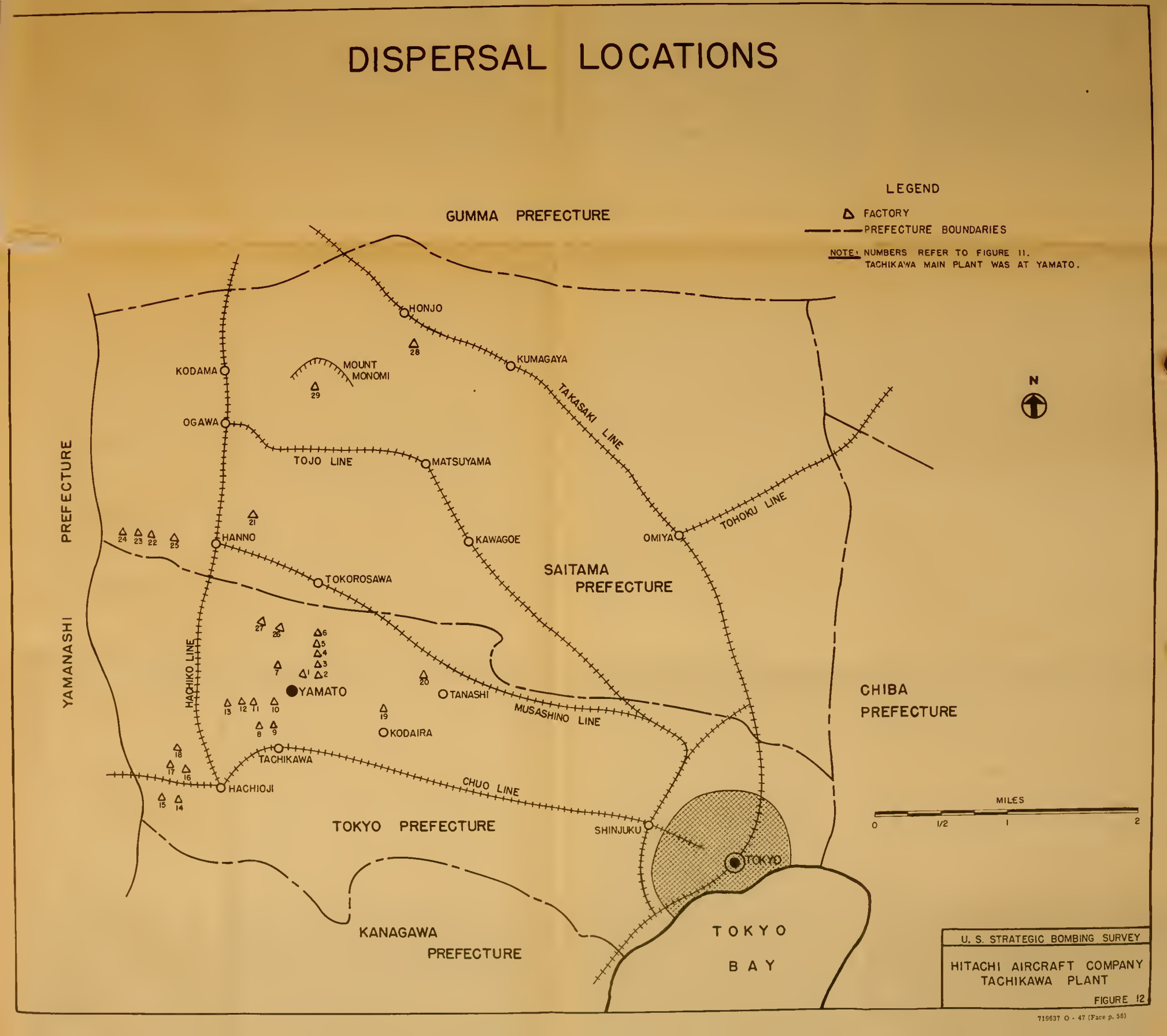
Although little was known about Tachikawa's production of the Ha–42 or Ha–33–62 engines, investigation subsequent to the end of the war has shown the former had been produced in July, August, September, October, and November 1943, and the latter was in production at the rate of 10 per month when the war ended.

VULNERABILITY

The plant was proved vulnerable not only to direct attack, which put it out of action, but also to shortages in supplies due to attacks on suppliers, and to air-raid alerts causing absenteeism and loss of man-hours.

The location of the plant in an area with many aircraft factories and industrial facilities was a further invitation to attack, and the early start and high degree of completion of the dispersal program reflects the management's realization of this.

DISPERSAL LOCATIONS



U. S. STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT COMPANY
TACHIKAWA PLANT

FIGURE 12

719637 O - 47 (Face p. 56)

Photo No. 4.—Machine tool installations in tunnel No. 4 at Yokota (dispersal location of Tachikawa plant).

Photo No. 5.—Entrance to Yokota tunnels (dispersal location of Tachikawa plant).

GENERAL PLAN AND BOMB DAMAGE

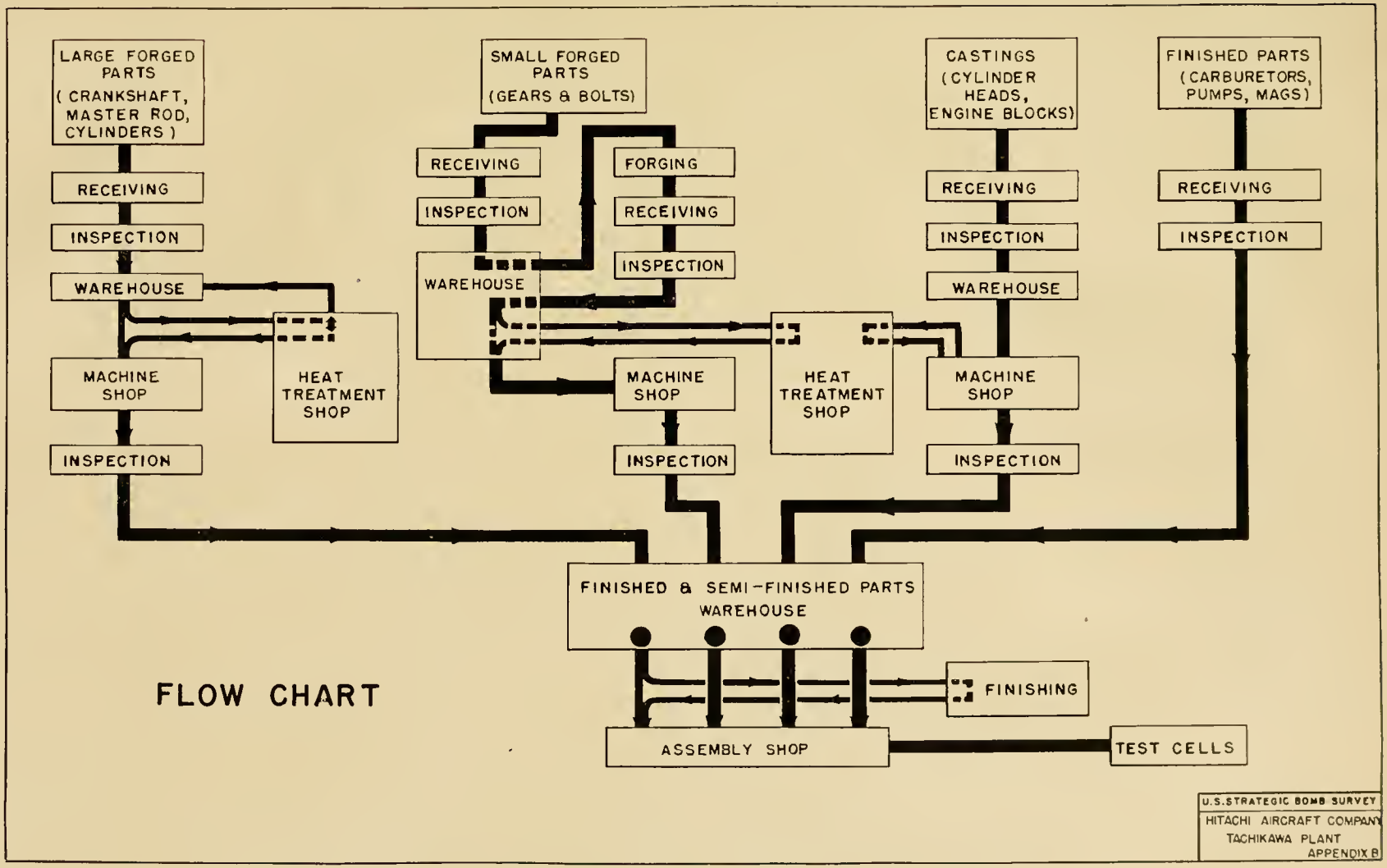
BLDG NO	FUNCTION	AREA (SQ FT)	CONSTRUCTION	% DAMAGE 17 FEB	% DAMAGE 24 APR
1	MACHINE AND ASSEMBLY SHOP	403,480	CONCRETE	30	90
2	JIG & TOOL MAKING SHOP	177,100	CONCRETE	70	90
3	EXPERIMENTAL SHOP	55,800	WOOD & CONCRETE	90	100
4	HEAT TREATMENT SHOP	50,400	CONCRETE	80	90
5	MACHINE SHOP	70,000	CONCRETE	0	0
6	DINING HALL	17,500	WOOD	100	100
7	PRESSING, PIPING & PAINTING SHOP	37,800	WOOD	70	20
8	BOILER ROOM	7,350	CONCRETE	0	70
9	ENGINE TESTING BLOCKS	31,920	CONCRETE	0	0
10	OFFICE	12,775	WOOD	0	100
11	WAREHOUSE	20,615	WOOD	40	0
12	DISPERSED MACHINE SHOPS	40,740	WOOD	—	30

O BOMB HITS, RAID OF 17 FEBRUARY 1945

o BOMB HITS, RAID OF 24 APRIL 1945

U. S. STRATEGIC BOMBING SURVEY

HITACHI AIRCRAFT COMPANY
TACHIKAWA PLANT
APPENDIX A


LARGE FORGED PARTS (CRANKSHAFT, MASTER ROD, CYLINDERS)
RECEIVING
INSPECTION
WAREHOUSE
MACHINE SHOP
INSPECTION
HEAT TREATMENT SHOP
SMALL FORGED PARTS (GEARS & BOLTS)
RECEIVING
INSPECTION
WAREHOUSE
FORGING
RECEIVING
INSPECTION
MACHINE SHOP
INSPECTION
HEAT TREATMENT SHOP
CASTINGS (CYLINDER HEADS, ENGINE BLOCKS)
RECEIVING
INSPECTION
WAREHOUSE
MACHINE SHOP
INSPECTION
FINISHED PARTS (CARBURETORS, PUMPS, MAGS)
RECEIVING
INSPECTION
FINISHED & SEMI-FINISHED PARTS WAREHOUSE
FINISHING
ASSEMBLY SHOP
TEST CELLS
FLOW CHART
U.S.STRATEGIC BOMB SURVEY
HITACHI AIRCRAFT COMPANY
TACHIKAWA PLANT
APPENDIX B

APPENDIX C

Employment statistics, Tachikawa plant, April 1943–August 1945, Hitachi Aircraft Co.

Year	Month	Men	Women	Productive	Nonproductive	Student	Total employees
1943	4	5,397	833	3,380	2,850		6,230
	5	5,547	853	3,400	3,000		6,400
	6	5,412	838	3,310	2,940		6,250
	7	5,507	843	3,360	2,990		6,350
	8	5,470	830	3,340	2,960		6,300
	9	5,430	820	3,320	2,930		6,250
	10	5,320	980	3,335	2,965		6,300
	11	5,480	1,020	3,450	3,050		6,500
	12	5,450	1,100	3,470	3,080		6,550
1944	1	6,723	1,227	4,210	3,740		7,950
	2	6,980	1,360	4,420	3,920		8,340
	3	7,430	1,930	4,960	4,400		9,360
	4	7,170	1,780	4,740	4,210	333	9,283
	5	7,850	2,140	5,400	4,590	618	10,608
	6	7,920	2,530	5,540	4,910	618	11,068
	7	8,030	2,650	5,650	5,030	608	11,288
	8	8,743	3,007	6,230	5,520	1,521	13,271
	9	8,826	3,224	6,400	5,650	1,846	13,896
	10	8,535	3,015	6,120	5,430	1,975	13,525
	11	8,370	2,980	6,030	5,320	1,964	13,314
	12	8,450	2,955	6,050	5,355	2,142	13,547
1945	1	8,387	2,914	6,000	5,301	2,207	13,508
	2	7,977	2,837	5,740	5,074	2,149	12,963
	3	8,706	2,761	6,080	5,387	1,996	13,463
	4	8,153	2,439	5,600	4,992	1,598	12,190
	5	7,776	2,303	5,390	4,689	1,890	11,969
	6	7,525	2,858	5,520	4,890	1,938	12,348
	7	7,315	2,805	5,370	4,750	1,755	11,875
	8	7,165	2,830	5,280	4,715		9,995

NOTE.—Student labor included in statistics for men and women and productive and nonproductive.

APPENDIX D

Hitachi Aircraft Co., Tachikawa plant, materials suppliers

Supplier	Location	Material
Hitachi Aircraft Co	Kawasaki	Al and Mg castings.
Hitachi Manufacturing Co	Ibaragi	Do.
Do	Tokyo	Do.
Riken Light Alloys Co	do	Bearings and copper alloys.
Morishima Co	do	Do.
Hitachi Manufacturing Co	Ibaragi	Forgings.
Mitsubishi Heavy Industries	Nagoya	Do.
Nippon Special Steel Co	Tokyo	Forgings and bars.
Nomura Manufacturing Co	Chiba	Do.
Nippon Pipe Co	Kawasaki	Bars.
Hitachi Manufacturing Co	Yasuki	Do.
Nippon Koshuha Manufacturing Co	Tokyo	Do.
Nippon Pipe Co	Chiba	Pipes.
Furukawa Electric Co	Nikko	Bars of light alloy.
Sumitomo Metal Industries	Osaka	Do.

APPENDIX E

Materials and parts (orders and receipts), Tachikawa plant, 1943–45, Hitachi Aircraft Co.

Materials	Fiscal year 1943					Percent received	Fiscal year 1944					Percent received	1945			Percent received
	Orders (tons)	Receipts					Orders (tons)	Receipts					Orders (tons)	Receipts		
		4–6	7–9	10–12	1–3			4–6	7–9	10–12	1–3			4–6	7–9	
Special steel:																
Forgings	1,392.000	312.000	360.000	346.000	296.000	94.5	1,974.000	378.000	350.000	232.000	166.000	54	457.000	56.800	12.230	15
Bar	807.300	191.500	221.000	212.550	182.300	100	1,280.000	232.000	215.000	142.000	102.000	54	108.000	34.000	7.540	38
Sheet	97.000	22.056	25.410	24.500	21.050	96	84.800	26.800	24.800	16.400	11.800	94	23.400	4.050	.869	21
Tube	30.700	6.700	7.740	7.740	6.380	92	57.500	8.130	7.520	4.960	3.580	42	2.860	1.220	.264	52
Wire	2.697	.640	.738	.710	.609	100	2.308	.776	.716	.475	.341	100	.711	.177	.025	19
Light alloy:																
Forgings	220.400	52.400	60.100	58.100	49.800	100	202.000	63.500	58.800	38.900	27.900	94	24.420	9.550	2.660	50
Castings	574.600	136.100	157.500	151.000	130.000	100	116.900	16.520	15.300	10.100	7.270	43	84.800	24.900	5.670	36
Bar	20.500	4.610	5.320	5.115	4.390	95	25.580	5.590	5.180	3.421	2.460	65	3.190	.840	.182	32
Sheet	.697	.141	.169	.169	.134	86	2.325	.171	.158	.105	.151	51	1.040	.258	.055	30
Tube	1.529	.286	.446	.424	.368	100	6.600	.469	.434	.287	.206	21	.165	.071	.015	52
Wire	.132	.019	.023	.022	.019	63	.353	.024	.022	.015	.011	20	.024	004	.008	50
Copper alloy:																
Forgings	1.832	.351	.405	.435	.334	83	2.270	.425	.394	.261	.187	25	.279	.064	.014	28
Castings	88.500	19.400	22.400	21.500	18.500	92	120.000	23.550	21.800	14.400	10.320	58	13.900	3.540	.765	31
Bar	50.000	10.780	12.410	11.910	10.240	91	86.700	13.050	12.080	8.000	5.660	45	7.930	1.964	424	30
Sheet	2.911	.402	.465	.446	.384	58	5.820	.488	.451	.299	.214	25	5.780	.735	.016	13
Tube	.978	.157	.182	.175	.150	63	2.580	.191	.177	.117	.084	22	.117	.029	.006	30
Wire	.955	.136	.157	.151	.129	60	4.900	.165	.152	.101	.073	10	.250	.025	.005	12
Components:	(*Units*)						(*Units*)						(*Units*)			
Carburetor	3,049	671	773	745	640	93	3,440	682	630	420	331	60	920	112	26	15
Magneto	5,020	1,230	1,310	1,400	1,080	100	60,000	1,364	1,263	826	460	66	1,160	213	54	23
Oil pump	2,530	560	663	710	541	98	2,930	686	631	417	299	69	450	110	28	31
Fuel pump	2,489	563	661	715	550	100	3,350	681	633	421	280	60	900	104	31	15
Injection pump	2,470	570	670	700	530	100	3,320	690	630	450	297	62	435	102	24	29
Starter	2,630	562	650	726	536	94	2,580	692	636	410	299	79	180	105	21	70

APPENDIX F

Tachikawa plant, capacity, planned and actual production, April 1943–September 1945, Hitachi Aircraft Company

Type of engine	1943 (month)										1944 (month)													1945 (month)													Grand Total
	4	5	6	7	8	9	10	11	12	Total	1	2	3	4	5	6	7	8	9	10	11	12	Total	1	2	3	4	5	6	7	8	9	10	11	12	Total	
Ha-12 (Ha 21 mod-11):																																					
Capacity	18	12	5	10	30	30	35	35	35	210	35	35	30										100														310
Planned	12	8	3	7	20	20	25	25	25	145	25	25	20										70														215
Actual	12	8	3	7	20	10	13	17	26	116	19	20	0	5	25	30							99														215
Ha-13 (Ha-23-mod-13):																																					
Capacity	30	40	35	25						130																											130
Planned	22	30	25	14						91																											91
Actual	22	30	25	14						91																											91
Ha-13 KO (Ha-23-mod-22, 23, 24):																																					
Capacity	200	200	200	240	240	240	200	200	200	1,920	220	220	220	240	250	250	250	250	280	270	270	200	2,920	150	40	60	30	20	20	20	20					360	5,200
Planned	138	136	135	160	165	160	135	135	135	1,299	145	145	144	160	170	170	170	170	190	178	170	130	1,942	120	110	100	90	80	60	60	40					660	3,901
Actual	138	136	135	160	165	170	163	163	167	1,397	166	158	45	122	192	178	178	128	186	70	145	145	1,713	141	30	53	24	14	8	10						280	3,390
Ha-42 (Ha-22-mod-11):																																					
Capacity				15	20	30	40	20		125																											125
Planned				10	15	20	15			60																											60
Actual				10	12	7	22	9		60																											60
Ha-26 (Ha-31-mod-15):																																					
Capacity	10	10	8	35	35	35	40	50	60	283	70	90	90	100	80	80	80	80	0	30	40	60	800	70	20	15	10	5									120	1,203
Planned	8	7	5	24	25	25	30	35	40	199	50	65	65	68	55	55	55	60	0	24	30	50	577	60	60	60											180	956
Actual	8	7	5	24	25	25	30	28	42	194	45	74	5	51	76	57	60	6	4	7	24	22	431	20	14	13	25	7	0	2						90	715
Ha-112 (Ha-33-mod-62):																																					
Capacity														1	2	5	7	10	15	20	30	40	130	20	10	20	20	40	50	60	70					290	420
Planned														1	2	2	10	20	40	50	60	70	255	80	90	100	20	30	40	60	100	120	70	80	90	880	1,135
Actual																2	0	1	2	2	0	0	7	4	2	2	6	11	7	10						42	49
Total:																																					
Capacity	258	262	248	325	325	335	315	305	295	2,668	325	345	340	341	332	335	337	340	295	320	340	300	3,950	240	70	95	60	65	70	80	90					770	7,388
Planned	180	181	168	215	225	225	205	195	200	1,794	220	235	229	229	227	227	235	250	230	252	260	250	2,844	260	260	260	110	110	100	120	140	120	70	80	90	1,720	6,358
Actual	180	181	168	215	222	212	228	217	235	1,858	230	252	50	178	293	267	238	135	192	79	169	167	2,250	174	46	68	55	32	15	22						412	4,520

NOTE.—Engine designations in parentheses are new Army-Navy designations.

UNITED STATES STRATEGIC BOMBING SURVEY

LIST OF REPORTS

The following is a bibliography of reports resulting from the Survey's studies of the European and Pacific wars. Those reports marked with an asterisk (*) may be purchased from the Superintendent of Documents at the Government Printing Office, Washington, D. C.

European War

OFFICE OF THE CHAIRMAN

*1 The United States Strategic Bombing Survey: Summary Report (European War)
*2 The United States Strategic Bombing Survey: Overall Report (European War)
*3 The Effects of Strategic Bombing on the Germany War Economy

AIRCRAFT DIVISION

(By Division and Branch)

*4 Aircraft Division Industry Report
5 Inspection Visits to Various Targets (Special Report)

Airframes Branch

6 Junkers Aircraft and Aero Engine Works, Dessau, Germany
7 Erla Maschinenwerke G m b H, Heiterblick, Germany
8 A T G Maschinenbau, G m b H, Leipzig (Mockau), Germany
9 Gothaer Waggonfabrik, A G, Gotha, Germany
10 Focke Wulf Aircraft Plant, Bremen, Germany
11 Messerschmitt A G, Augsburg, Germany — Over-all Report; Part A; Part B; Appendices I, II, III
12 Dornier Works, Friedrichshafen & Munich, Germany
13 Gerhard Fieseler Werke G m b H, Kassel, Germany
14 Wiener Neustaedter Flugzeugwerke, Wiener Neustadt, Austria

Aero Engines Branch

15 Bussing NAG Flugmotorenwerke G m b H, Brunswick, Germany
16 Mittel-Deutsche Motorenwerke G m b H, Taucha, Germany
17 Bavarian Motor Works Inc, Eisenach & Durrerhof, Germany
18 Bayerische Motorenwerke A G (BMW) Munich, Germany
19 Henschel Flugmotorenwerke, Kassel, Germany

Light Metal Branch

20 Light Metals Industry of Germany — Part I, Aluminum; Part II, Magnesium
21 Vereinigte Deutsche Metallwerke, Hildesheim, Germany
22 Metallgussgesellschaft G m b H, Leipzig, Germany
23 Aluminiumwerk G m b H, Plant No. 2, Bitterfeld, Germany
24 Gebrueder Giulini G m b H, Ludwigshafen, Germany
25 Luftschiffbau, Zeppelin G m b H, Friedrichshafen on Bodensee, Germany
26 Wieland Werke A G, Ulm, Germany
27 Rudolph Rautenbach Leichmetallgiessereien, Solingen, Germany
28 Lippewerke Vereinigte Aluminiumwerke A G, Lunen, Germany
29 Vereinigte Deutsche Metallwerke, Heddernheim, Germany
30 Duerener Metallwerke A G, Duren Wittenau-Berlin & Waren, Germany

AREA STUDIES DIVISION

*31 Area Studies Division Report
32 A Detailed Study of the Effects of Area Bombing on Hamburg
33 A Detailed Study of the Effects of Area Bombing on Wuppertal
34 A Detailed Study of the Effects of Area Bombing on Dusseldorf
35 A Detailed Study of the Effects of Area Bombing on Solingen
36 A Detailed Study of the Effects of Area Bombing on Remscheid
37 A Detailed Study of the Effects of Area Bombing on Darmstadt
38 A Detailed Study of the Effects of Area Bombing on Lubeck
39 A Brief Study of the Effects of Area Bombing on Berlin, Augsburg, Boehum, Leipzig, Hagen, Dortmund, Oberhausen, Schweinfurt, and Bremen

CIVILIAN DEFENSE DIVISION

*40 Civilian Defense Division—Final Report
41 Cologne Field Report
42 Bonn Field Report
43 Hanover Field Report
44 Hamburg Field Report—Vol I, Text; Vol II, Exhibits
45 Bad Oldesloe Field Report
46 Augsburg Field Report
47 Reception Areas in Bavaria, Germany

EQUIPMENT DIVISION

Electrical Branch

*48 German Electrical Equipment Industry Report
49 Brown Boveri et Cie, Mannheim Kafertal, Germany

Optical and Precision Instrument Branch

*50 Optical and Precision Instrument Industry Report

Abrasives Branch

*51 The German Abrasive Industry
52 Mayer and Schmidt, Offenbach on Main, Germany

Anti-Friction Branch

*53 The German Anti-Friction Bearings Industry

Machine Tools Branch

*54 Machine Tools & Machinery as Capital Equipment
*55 Machine Tool Industry in Germany
56 Herman Kolb Co., Cologne, Germany
57 Collet and Engelhard, Offenbach, Germany
58 Naxos Union, Frankfort on Main, Germany

MILITARY ANALYSIS DIVISION

59 The Defeat of the German Air Force
60 V-Weapons (Crossbow) Campaign
61 Air Force Rate of Operation
62 Weather Factors in Combat Bombardment Operations in the European Theatre
63 Bombing Accuracy, USAAF Heavy and Medium Bombers in the ETO
64 Description of RAF Bombing
64a The Impact of the Allied Air Effort on German Logistics

MORALE DIVISION

*64b The Effects of Strategic Bombing on German Morale (Vol. I & II)

Medical Branch

*65 The Effect of Bombing on Health and Medical Care in Germany

MUNITIONS DIVISION

Heavy Industry Branch

*66 The Coking Industry Report on Germany
67 Coking Plant Report No. 1, Sections A, B, C, & D
68 Gutehoffnungshuette, Oberhausen, Germany
69 Friedrich-Alfred Huette, Rheinhausen, Germany
70 Neunkirchen Eisenwerke A G, Neunkirchen, Germany
71 Reichswerke Hermann Goering A G, Hallendorf Germany
72 August Thyssen Huette A G, Hamborn, Germany
73 Friedrich Krupp A G, Borbeck Plant, Essen, Germany
74 Dortmund Hoerder Huettenverein, A G, Dortmund, Germany
75 Hoesch A G, Dortmund, Germany
76 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany

Motor Vehicles and Tanks Branch

*77 German Motor Vehicles Industry Report
*78 Tank Industry Report
79 Daimler Benz A G, Unterturkheim, Germany
80 Renault Motor Vehicles Plant, Billancourt, Paris
81 Adam Opel, Russelheim, Germany
82 Daimler Benz-Gaggenau Works, Gagenau, Germany
83 Maschinenfabrik Augsburg-Nurnberg, Nurnberg, Germany
84 Auto Union A G, Chemnitz and Zwickau, Germany
85 Henschel & Sohn, Kassel, Germany
86 Maybach Motor Works, Friedrichshafen, Germany
87 Voigtlander, Maschinenfabrik A G, Plauen, Germany
88 Volkswagenwerke, Fallersleben, Germany
89 Bussing NAG, Brunswick, Germany
90 Muehlenbau Industrie A G (Miag) Brunswick, Germany
91 Friedrich Krupp Grusonwerke, Magdeburg, Germany

Submarine Branch

92 German Submarine Industry Report
93 Maschinenfabrik Augsburg-Nurnberg A G, Augsburg, Germany
94 Blohm and Voss Shipyards, Hamburg, Germany
95 Deutschewerke A. G, Kiel, Germany
96 Deutsche Schiff und Maschinenbau, Bremen, Germany
97 Friedrich Krupp Germaniawerft, Kiel, Germany
98 Howaldtswerke A. G, Hamburg, Germany
99 Submarine Assembly Shelter, Farge, Germany
100 Bremer Vulkan, Vegesack, Germany

Ordnance Branch

*101 Ordnance Industry Report
102 Friedrich Krupp Grusonwerke A. G Magdeburg, Germany
103 Bochumer Verein fuer Gusstahlfabrikation A G, Bochum, Germany
104 Henschel & Sohn, Kassel, Germany
105 Rheinmetall-Borsig, Dusseldorf, Germany
106 Hermann Goering Werke, Braunschweig, Hallendorf, Germany
107 Hannoverische Maschinenbau, Hanover, Germany
108 Gusstahlfabrik Friedrich Krupp, Essen, Germany

OIL DIVISION

*109 Oil Division, Final Report
*110 Oil Division, Final Report, Appendix
*111 Powder, Explosives, Special Rockets and Jet Propellants, War Gases and Smoke Acid (Ministerial Report #1)
112 Underground and Dispersal Plants in Greater Germany
113 The German Oil Industry, Ministerial Report Team 78
114 Ministerial Report on Chemicals

Oil Branch

115 Ammoniakwerke Merseburg G m b H, Leuna, Germany—2 Appendices
116 Braunkohle Benzin A G, Zeitz and Bohlen, Germany-Wintershall A G, Leutzkendorf, Germany
117 Ludwigshafen-Oppau Works of I G Farbenindustrie A G, Ludwigshafen, Germany
118 Ruhroel Hydrogenation Plant, Bottrop-Boy, Germany, Vol. I, Vol. II
119 Rhenania Ossag Mineraloelwerke A G, Harburg Refinery, Hamburg, Germany
120 Rhenania Ossag Mineraloelwerke A G, Grasbrook Refinery, Hamburg, Germany
121 Rhenania Ossag Mineraloelwerke A G, Wilhelmsburg Refinery, Hamburg, Germany
122 Gewerkschaft Victor, Castrop-Rauxel, Germany, Vol. I & Vol. II
123 Europaeische Tanklager und Transport A G, Hamburg, Germany
124 Ebano Asphalt Werke A G, Harburg Refinery, Hamburg, Germany
125 Meerbeck Rheinpreussen Synthetic Oil Plant—Vol. I & Vol. II

Rubber Branch

126 Deutsche Dunlop Gummi Co., Hanau on Main, Germany
127 Continental Gummiwerke, Hanover, Germany
128 Huels Synthetic Rubber Plant
129 Ministerial Report on German Rubber Industry

Propellants Branch

130 Elektrochemischewerke, Munich, Germany
131 Schoenebeck Explosive Plant, Lignose Sprengstoff Werke G m b H, Bad Salzemen, Germany
132 Plants of Dynamit A G, Vormal, Alfred Nobel & Co., Troisdorf, Clausthal, Drummel and Duneberg, Germany
133 Deutsche Sprengchemie G m b H, Krailburg, Germany

OVER-ALL ECONOMIC EFFECTS DIVISION

134 Over-all Economic Effects Division Report
Gross National Product
Kriegseilberichte
Hermann Goering Works
Food and Agriculture
} Special papers which together comprise the above report
134a Industrial Sales Output and Productivity

PHYSICAL DAMAGE DIVISION

134b Physical Damage Division Report (ETO)
135 Villacoublay Airdrome, Paris, France
136 Railroad Repair Yards, Malines, Belgium
137 Railroad Repair Yards, Louvain, Belgium
138 Railroad Repair Yards, Hasselt, Belgium
139 Railroad Repair Yards, Namur, Belgium
140 Submarine Pens, Brest, France
141 Powder Plant, Angouleme, France
142 Powder Plant, Bergerac, France
143 Coking Plants, Montigny & Liege, Belgium
144 Fort St. Blaise Verdun Group, Metz, France
145 Gnome et Rhone, Limoges, France
146 Michelin Tire Factory, Clermont-Ferrand, France
147 Gnome et Rhone Aero Engine Factory, Le Mans, France
148 Kugelfischer Bearing Ball Plant, Ebelsbach, Germany
149 Louis Breguet Aircraft Plant, Toulouse, France
150 S. N. C. A. S. E. Aircraft Plant, Toulouse, France
151 A. I. A. Aircraft Plant, Toulouse, France
152 V Weapons in London
153 City Area of Krefeld
154 Public Air Raid Shelters in Germany
155 Goldenberg Thermal Electric Power Station, Knapsack, Germany
156 Brauweiler Transformer & Switching Station, Brauweiler, Germany
157 Storage Depot, Nahbollenbach, Germany
158 Railway and Road Bridge, Bad Munster, Germany
159 Railway Bridge, Eller, Germany
160 Gustloff-Werke Weimar, Weimar, Germany
161 Henschell & Sohn G m b H, Kassel, Germany
162 Area Survey at Pirmasens, Germany
163 Hanomag, Hanover, Germany
164 M A N Werke Augsburg, Augsburg, Germany
165 Friedrich Krupp A G, Essen, Germany
166 Erla Maschinenwerke, G m b H, Heiterblick, Germany
167 A T G Maschinenbau G m b H, Mockau, Germany
168 Erla Maschinenwerke G m b H, Mockau, Germany
169 Bayerische Motorenwerke, Durrerhof, Germany
170 Mittel-Deutsche Motorenwerke G m b H, Taucha, Germany
171 Submarine Pens Deutsche-Werft, Hamburg, Germany
172 Multi-Storied Structures, Hamburg, Germany
173 Continental Gummiwerke, Hanover, Germany
174 Kassel Marshalling Yards, Kassel, Germany
175 Ammoniawerke, Merseburg, Leuna, Germany
176 Brown Boveri et Cie, Mannheim, Kafertal, Germany
177 Adam Opel A G, Russelsheim, Germany
178 Daimler-Benz A G, Unterturkheim, Germany
179 Valentin Submarine Assembly, Farge, Germany
180 Volkswaggonwerke, Fallersleben, Germany
181 Railway Viaduct at Bielefeld, Germany
182 Ship Yards Howaldtswerke, Hamburg, Germany
183 Blohm and Voss Shipyards, Hamburg, Germany
184 Daimler-Benz A G, Mannheim, Germany
185 Synthetic Oil Plant, Meerbeck-Hamburg, Germany
186 Gewerkschaft Victor, Castrop-Rauxel, Germany
187 Klockner Humboldt Deutz, Ulm, Germany
188 Ruhroel Hydrogenation Plant, Bottrop-Boy, Germany
189 Neukirchen Eisenwerke A G, Neukirchen, Germany
190 Railway Viaduct at Altenbecken, Germany
191 Railway Viaduct at Arnsburg, Germany
192 Deurag-Nerag Refineries, Misburg, Germany
193 Fire Raids on German Cities
194 I G Farbenindustrie, Ludwigshafen, Germany, Vol I & Vol II
195 Roundhouse in Marshalling Yard, Ulm, Germany
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